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Monthly Report

September 1987 Number 229

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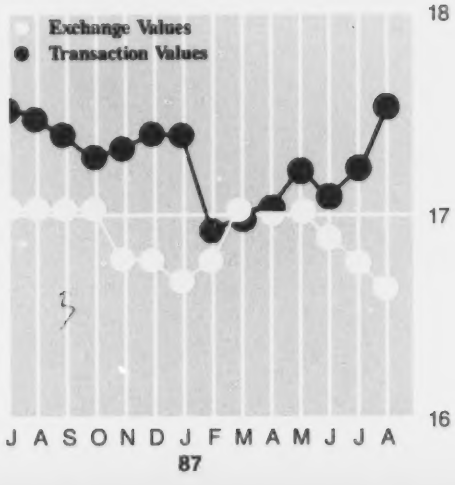

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EXECUTIVE SUMMARY
REPORT 229
(All data as of August 31, 1987)

Exchange Value
$16.65, down $0.10

The **Exchange Value** is **$16.65** per pound U_3O_8, down $0.10 since last month.The US Premium (relative to the Exchange Value) is $2.35, down $0.15 since last month.

UF_6 Value
$47.00, down $0.50

The **UF_6 Value** is **$47.75** per kilogram U as UF_6, down $0.50 since last month.The US Premium (relative to the UF_6 Value) is $6.00, down $0.50 since last month.

Transactions

Six recent natural uranium sales are reported, involving **1.6 million** pounds equivalent U_3O_8. All of the sales involved spot or near-term delivery, and four met the conditions for inclusion in the Transaction Value. Active spot and near-term **uranium supply** amounts to **3.7 million** pounds U_3O_8 equivalent, up 900 thousand pounds since last month. Active spot and near-term **uranium demand** totals **2.0 million** pounds, down 460 thousand pounds from last month. The spot and near-term **supply-demand ratio** increased to **1.8 to 1**.

Transaction Value
$17.55, up $0.25

The **Transaction Value** is $17.55 per pound U_3O_8, **up $0.25** since last month. The calculation includes transactions involving a total of 4.2 million pounds U_3O_8 and equivalent UF_6, of which 1.4 milion pounds are US-origin, and covers a period of 3 months.

Loan Rate
4%, up one percent

The **Loan Rate** is **4 percent** per annum, up one percent.

Conversion Value
$1.90, unchanged

The **Conversion Value** is **$1.90** per pound U as UF_6, unchanged since last month. Active secondary market supply for conversion services for delivery within three years totals 750 thousand pounds U as UF_6. Active demand totals 440 thousand pounds U as UF_6. One secondary market conversion transaction is reported.

SWU Value for delivery within one year: $75, unchanged

The **SWU Value** at .3% tails assay and for delivery within one year is **$75** per SWU, unchanged since last month. Two secondary market SWU transactions are reported.

* * *

Essay

Mr. J. R. Wolcott, former Chairman of Nuexco, argues in this essay that the US nuclear industry must attempt several changes if it is to reestablish itself in coming years. It must change existing concepts regarding nuclear plants and plant sites, and it must promote its inherent environmental advantages. To regain the industry's lost momentum, a new prototype construction program should be undertaken, to evaluate advanced technologies and develop new reactor plans.

Raw Materials

Since the mid-1960s, productivity factors in US uranium mines have varied considerably. This article compares mine productivity, production and employment in open-pit and underground mines during the period from 1967 to the present.

Analysis and Commentary

Continued low spot and near-term prices in the uranium market have placed increased pressure on world uranium producers. Utilities have become both more price conscious and more sophisticated in their procurement programs, encouraging intense competition among suppliers. The keys to survival for producers will continue to be flexibility in terms and conditions of sales and low relative production costs.

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NUEXCO REPORT 229 FIGURES OF THE MONTH (August 31, 1987)	This Month (Report 229)	Last Month (Report 228)	12 Months Ago (Report 217)
Exchange Value (US $ per pound U_3O_8 equivalent)	16.65	16.75	17.00
US Premium for the Exchange Value (US$ per pound U_3O_8)	2.35	2.50	—
UF_6 Value (US $ per kilogram U as UF_6)	47.00	47.50	48.00
US Premium for the UF_6 Value (US$ per kgU as UF_6)	6.00	6.50	—
Transaction Value (US $ per pound U_3O_8 equivalent)	17.55	17.30	17.45
Loan Rate (Per Annum)	4%	3%	4%
Conversion Value (US $ per pound U as UF_6)	1.90	1.90	1.90
Near-Term Uranium Supply[1] (millions of pounds U_3O_8)	3.7	2.8	4.2
Near-Term Uranium Demand[2] (millions of pounds U_3O_8)	2.0	2.5	1.5
Near-Term Supply-Demand Ratio	1.8	1.1	2.9
Recent Uranium Sales:[3]			
Number of Transactions	6	8	5
Quantity of Material (Millions of pounds U_3O_8 equivalent)	1.6	1.8	1.5
Nuexco SWU Value:			
at 0.3 tails assay and delivery within one year (US $ per SWU)	75	75	78
US DOE SWU Prices:			
USEC	119.00[4]	119.00[4]	125.00[5]
AFC	153.00[6]	153.00[6]	153.00[6]
Requirements	157.00[6]	157.00[6]	157.00[6]
Incentive Price	90.00[7]	90.00[7]	—
Market Value of Enriched UF_6[8]: (US $ per kgU as UF_6)			
2.5 w/o U_{235}	446	447	458
3.0 w/o U_{235}	570	572	586
3.5 w/o U_{235}	697	699	717
4.0 w/o U_{235}	825	827	849

[1]Active inquiries to sell, for delivery within 12 months after contract signing.
[2]Active inquiries to purchase, for delivery within 12 months after contract signing.
[3]Uranium sales only; does not include loans, conversion, or SWU transactions.
[4]Effective since 10/1/85.
[5]Effective since 10/1/86.
[6]Effective since 10/1/85.
[7]Effective since 10/1/86, for up to 30% of annual requirements.
[8]Calculated using the Nuexco Exchange Value, Conversion Value, and 0.30 percent tails assay. From 4/30/85 to 11/30/85, calculations used the Nuexco SWU Value for DOE origin and delivery by the end of FY 86. As of 12/31/85, calculations use the SWU Value for delivery within one year.

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MONTHLY REPORT ON THE NUCLEAR FUEL MARKET

September 1987 No. 229

R. GENE CLARK, *EDITOR* CHARLES B. LEWIS, *ASSISTANT EDITOR*

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August 31, 1987	Market Values	Active Supply[1] (thousands)	Active Demand[1] (thousands)
EXCHANGE VALUE	**$16.65**/lb. U_3O_8	3,730	2,025
US Premium	**$2.35**		
UF_6 VALUE	**$47.00**/kgU		
US Premium	**$6.00**		
CONVERSION VALUE	**$1.90**/lb. U as UF_6	750	440
SWU VALUE			
0.3 tails assay:			
delivery within one year	$75/SWU		
LOAN RATE	**4%**/annum	600	100

	$/lb. U_3O_8	Millions of Pounds	Number of Transactions	Number of Months
TRANSACTION VALUE	**17.55**	**4.2**	**19**	**3**

[1]Supply and demand tables in the *Current Market Data* section of this Report detail the numbers for each category.

DEFINITIONS

1. The **Exchange Value** is Nuexco's judgment of the price at which transactions for significant quantities of natural uranium concentrates could be concluded as of the date indicated.
2. The **UF_6 Value** is Nuexco's judgment of the price at which spot and near-term transactions for significant quantities of natural uranium hexafluoride could be concluded as of the date indicated.
3. The **Conversion Value** is Nuexco's judgment of the price at which spot and near-term transactions for significant quantities of conversion services could be concluded in the secondary market as of the date indicated.
4. The **SWU Values** represent Nuexco's judgment of the price at which transactions for the sale of significant quantities of SWUs of stated origin for delivery in the specified time period could be concluded as of the date indicated.
5. The **Loan Rate** is Nuexco's judgment of the annual interest rate at which uranium loans could be concluded as of the date indicated.
6. The **Transaction Value** is a weighted average price of recent natural uranium sales transactions. The calculation is based on prices paid in:
a. Transactions closed within the previous three month period for which delivery is scheduled within one year of the transaction date;
b. At least ten transactions;
c. Transactions involving a sum total of at least 2 million pounds U_3O_8 equivalent.
The sample time is extended as necessary to include these minima. Other currencies are converted to US dollars using conversion rates in effect on or near the transaction date.
7. **The US Premium** is Nuexco's judgment of the incremental price (relative to the Exchange Value or UF_6 Value, as applicable) at which transactions for significant quantities of natural uranium could be concluded as of the date indicated, if the buyer will accept only US-origin.

DERIVATIONS AND COMMENTS

1. All Market Values are based on:
a. Data from recently completed transactions.
b. Data from pending transactions.
c. Firm bids to buy or borrow, and firm offers to sell or lend.
d. Prices purchasers or rates borrowers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy or borrow, and prices sellers or rates lenders have expressed awillingness to accept, but for which Nuexco is not aware of firm offers to sell or lend.
2. Prices associated with deliveries under old or renegotiated contracts or other than arm's-length transactions are not included in the determination of these Market Values.
3. In the determination of the Conversion Value, Nuexco does not consider transportation charges other than those customarily provided by primary suppliers of conversion services.
4. The prices of conversion services or SWUs delivered under long-term contracts with primary suppliers are not considered in the determination of either the Conversion Value or SWU Value.
5. For the SWU Value, Nuexco converts SWU prices at varying tails and product assays to equivalent SWU prices at a tails assay of 0.30 weight percent U_{235} and a product assay of 3.0 weight-percent U_{235}, assuming feed costs corresponding to the Nuexco Exchange and Conversion Values determined as of the same date.
6. In calculating the Transaction Value, Nuexco does not account for the price of uranium delivered in connection with contracts which call for "market price" mechanisms. This exclusion applies particularly to contracts in which delivery prices are expressed as a function of future Exchange Values or any other indeterminate variable. Also excluded from the calculation are any other transactions in which the delivery price is defined in such a way that it cannot currently be determined.

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NATURAL URANIUM AND SECONDARY MARKET CONVERSION

(All data as of August 31, 1987)

The **Exchange Value** is **$16.65** per pound U_3O_8, down $0.10 since last month. **US-origin** uranium is commanding a **premium** (relative to the Exchange Value) of **$2.35** per pound U_3O_8 (down $0.15). **Active supply** of natural uranium (concentrates and UF_6) for spot or near-term delivery totals 3,730,000 pounds U_3O_8 equivalent, up 900,000 pounds since last month. The corresponding figure for **active demand** is 2,025,000 pounds, down 460,000 pounds. The spot and near-term **supply-demand** ratio increased to 1.8 to 1.

The *Current Market Data* section of this Report lists **six** natural uranium sales, totaling **1.6 million pounds** U_3O_8 equivalent.

The **Transaction Value** is **$17.55** per pound U_3O_8, up $0.25 since last month. The calculation extends over a 3-month period and includes 19 transactions involving 4.2 million pounds equivalent U_3O_8.

The **UF_6 Value** is **$47.00** per kilogram U in UF_6, down $0.50 since last month. US-origin UF_6 is commanding a **premium** (relative to the UF_6 Value) of $6.00 per kilogram U in the form of UF_6, down $0.50. Three transactions involving UF_6 are reported, totaling approximately 1.1 million pounds equivalent U_3O_8. Demand for UF_6 remains weak.

The **Conversion Value** is **$1.90** per pound U as UF_6, unchanged since last month. Active supply of secondary market conversion services totals 750 thousand pounds U as UF_6. Active demand totals 440 thousand pounds U as UF_6. One secondary market conversion transaction is reported.

The **Loan Rate** is **4 percent** per annum, up one percentage point since last month.

* * *

The Exchange Value declined $0.10 this month to $16.65 per pound U_3O_8, and the Premium (relative to the Exchange Value) for US-origin slipped $0.15 to $2.35 per pound U_3O_8, reflecting a slight softening in the markets for both US and non-US-origin uranium. In the USA, some demand exists for US-origin material, but most buyers have been waiting for further developments in the US Producers vs. DOE lawsuit before making firm procurement plans.

As of September 3, the US Tenth Circuit Court of Appeals had not acted on DOE's July 23, 1987 emergency motion requesting a stay of the July 20 decision upholding Judge Carrigan's June 1986 ruling in favor of the producers. Meanwhile, DOE has continued to enrich non-US-origin uranium for use in US reactors, asserting that earlier Congressional action essentially gives DOE the right to enrich non-US-origin feed until the matter is finally resolved by the US Supreme Court. The stated basis for this position is language contained in the appropriations bill funding DOE for Fiscal Year 1987, in which the Conference Committee Report described a resolution to the lawsuit as "a decision by the Court of Appeals or the Supreme Court, should *certiorari* be granted." DOE refers to this language as being tatamount to a "legislative stay."

The Court of Appeals mandate of its July 20, 1987 decision will take effect on September 4, 45 days after the decision, unless prior to that date the Court grants DOE's motion for stay or unless the US Supreme Court should grant a stay prior to that date. As of September 3, DOE had not requested such a stay from the Supreme Court. Upon the mandate becoming effective, DOE is obliged thereafter to follow Judge Carrigan's June 1986 order. Whether DOE will conduct its enrichment activities in conformity with the court's decision, or continue to assert that it has a legislative stay and therefore is excused from the mandate, is unknown at this time. Many observers anticipate that the Appeals Court will rule on DOE's emergency motion, either granting or denying the stay, but the Court need not do so and can simply let the mandate become effective on September 4 without further action.

Although following last month's Appeals Court ruling DOE indicated that it was preparing to file petition for *writ of certiorari* to the Supreme Court for a review of the case, DOE has not as yet filed its petition. Since the granting of a stay by the Appeals Court might be presumed to be at least partially based on DOE's intent to take the case to the Supreme Court, DOE's failure to follow up on its announced course of action is at least curious, and could influence the Appeals Court's deliberation on the stay request.

Numerous motions and briefs have been filed in the Appeals Court by, and in support of, both sides in the case with respect to the granting of the stay and the effectiveness presently of the District Court's decision. The states of Colorado, New Mexico, Nevada, Utah, and Wyoming have

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filed amici curiae briefs, opposing DOE's "legislative stay" interpretation, and also reminding the court that the House of Representatives had passed an NRC appropriations bill for FY 1988 and 1989 that authorized the NRC to use the funds to implement sections 161(b) and 161(p) of the Atomic Energy Act, which would enable the NRC and DOE jointly to apply conditions to nuclear plant licenses, restricting utilities' uranium purchases to US-origin. And in a letter to the Tenth Circuit Court of Appeals, lawyers for the plaintiffs (the Producers) protested DOE's refusal to comply with the court decision, saying "In effect, the government has given itself a stay of this Court's Order by its self-serving interpretation of legislative action on a continuing appropriations bill."

If DOE's motion for stay is denied or the Appeals Court takes no action by September 4, DOE may request a stay of Judge Carrigan's order from Justice Byron White (or other available Justice) of the Supreme Court. Whether DOE will do so may depend on how enforcement proceedings transpire in Judge Carrigan's court. In the interim, DOE has until October to file its petition for *writ of certiorari*. Realistically there are many procedural strategies that may yet be played out by both sides and it will probably be at least several months before the issue is resolved. Meanwhile, it is very doubtful that Congress will be able in the near term to agree upon legislation that will resolve the matter. Until DOE's legal responsibilities with respect to the status of a restriction on enrichment of non-US-origin uranium for use in US reactors are clarified, the market for US-origin uranium will continue to reflect buyers' uncertainty over possible restriction levels.

* * *

Three spot and near-term U_3O_8 transactions are reported this month, involving approximately 500 thousand pounds. All of those transactions involved US-origin uranium; one of the transactions for a significant quantity of material occurred earlier this summer, and the other two involved August purchases of smaller quantities of material.

Three UF_6 transactions also are reported, involving 1.1 million pounds U_3O_8 equivalent. One of those transactions involved a US utility purchasing non-US-origin UF_6 for virtually immediate delivery. Believing that restrictions on the use of non-US-origin uranium will result from the current litigation between the US producers and DOE, at least some US utilities are considering accelerating their enrichment schedules. Even with DOE concurrence, such transactions require the availability of non-US-origin feed on extremely short notice to minimize the risk of holding such feed, which could not be utilized if restrictions were suddenly imposed. This potential demand suggests that UF_6 prices for immediate delivery could well be somewhat higher than prices for deliveries further out in time.

Since February 1987, the Transaction Value has shown a steady overall rise. The Transaction Value is a volume-weighted average of actual prices in recent transactions and is not differentiated according to origin of uranium. Because transactions involving US-origin typically carry higher prices, since April 1987 the Transaction Value and the Exchange Value have diverged and the Transaction Value is now about 5-percent higher than the Exchange Value.

* * *

The Loan Rate increased this month, primarily due to expectations that short-term loans could create possibilities for US utilities either to deliver non-US-origin uranium to DOE before being restricted from doing so, or to better manage short-term shortages in the event of a restriction. The rise in the Loan Rate is linked to an increase in this potential borrower interest, although no loan transactions are reported this month.

* * *

The Conversion Value is unchanged this month, and much of the secondary market demand, which is driven by a preference for immediate purchase and delivery of UF_6 rather than for purchase of U_3O_8 to be placed in inventory, has now dissipated.

ENRICHED URANIUM AND SWU

The SWU Value is unchanged this month, at $75 per SWU. Firm demand for secondary market SWU continues to be weak. Although a number of US utilities have solicited verbal offers for non-DOE SWU for short-term delivery, those actions seem to be due more to the evaluating of options should DOE be unable to enrich their non-US-origin feed, than to a firm demand for SWU.

The SWU Value of $75 is a representative price for a highly segmented market, in which prices being offered by sellers vary widely, depending on SWU origin, delivery location, and the flexibility of enrichment assay offered. At the low end of the price range are the prices being quoted by the non-western-origin SWU suppliers. These sellers are forced to discount their SWU below other sellers due to western utility buyers' perceived risk of non-supply. These

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sellers also tend to have restrictive feed delivery and origin requirements.

Near the middle of the range are sellers of either DOE-origin SWU commitments, whose buyers (if they are US utilities) run the risk of having to deliver high-priced US-origin feed for enrichment, or sellers of enriched uranium inventory, who are limited by constraints concerning location or product assay. Buyers of enriched inventory will usually have to buy additional higher-priced upgrade SWU to re-enrich the material to the desired assays.

At the upper end of the price spectrum are sellers of excess Eurodif or Urenco SWU commitments. These sellers can offer flexibility both in assay and in delivery location. Most such sellers are European, and the weakness of the US dollar relative to the European currencies has tended to raise sellers' offering prices for such SWU in US dollars.

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CURRENT MARKET DATA

EXCHANGE VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	per lb. U_3O_8 in Concentrates			per kg. U in Concentrates		
	This Month (Aug 31, 1987)	Last Month (Jul 31, 1987)	12 Months Ago (Aug 31, 1986)	This Month (Aug 31, 1987)	Last Month (Jul 31, 1987)	12 Months Ago (Aug 31, 1986)
Australia (dollar)	23.41	23.99	27.91	60.86	62.36	72.55
Belgium (comm. franc)	627.59	642.75	720.03	1,632	1,671	1,872
Canada (dollar)	21.94	22.32	23.66	57.05	58.01	61.51
EEC (ecu)	14.61	14.99	16.57	37.99	38.97	43.09
Finland (markka)	73.25	75.38	83.50	190.44	195.98	217.07
France (franc)	100.73	103.27	114.25	261.86	268.47	297.02
FRG (mark)	30.16	31.06	34.86	78.42	80.75	90.64
Italy (lira)	21,845	22,477	24,021	56,791	58,436	62,450
Japan (yen)	2,363	2,503	2,651	6,144	6,506	6,893
Netherlands (guilder)	33.99	34.98	39.26	88.38	90.93	102.07
South Africa (rand)	33.91	34.72	43.93	88.16	90.25	114.20
Spain (peseta)	2,031	2,117	2,274	5,281	5,505	5,911
Sweden (krona)	106.19	108.27	117.57	276.06	281.49	305.64
Switzerland (franc)	24.85	25.74	28.13	64.61	66.91	73.12
UK (pound)	10.19	10.50	11.49	26.50	27.30	29.87
US (dollar)	16.65	16.75	17.00	43.29	43.55	44.20

TRANSACTION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	per lb. U_3O_8 in Concentrates			per kg. U in Concentrates		
	This Month (Aug 31, 1987)	Last Month (Jul 31, 1987)	12 Months Ago (Aug 31, 1986)	This Month (Aug 31, 1987)	Last Month (Jul 31, 1987)	12 Months Ago (Aug 31, 1986)
Australia (dollar)	24.68	24.77	28.64	64.15	64.41	74.47
Belgium (comm. franc)	661.52	663.85	739.09	1,720	1,726	1,921
Canada (dollar)	23.13	23.05	24.29	60.13	59.92	63.14
EEC (ecu)	15.40	15.48	17.01	40.04	40.25	44.23
Finland (markka)	77.21	77.86	85.71	200.73	202.41	222.82
France (franc)	106.17	106.66	117.27	276.02	277.29	304.88
FRG (mark)	31.79	32.08	35.79	82.66	83.40	93.04
Italy (lira)	23,025	23,215	24,657	59,861	60,354	64,104
Japan (yen)	2,491	2,585	2,721	6,476	6,720	7,075
Netherlands (guilder)	35.83	36.12	40.30	93.15	93.92	104.77
South Africa (rand)	35.74	35.85	45.09	92.92	93.21	117.22
Spain (peseta)	2,141	2,187	2,334	5,566	5,685	6,067
Sweden (krona)	111.93	111.83	120.68	290.98	290.73	313.74
Switzerland (franc)	26.19	26.58	28.87	68.10	69.11	75.06
UK (pound)	10.74	10.85	11.79	27.93	28.20	30.66
US (dollar)	17.55	17.30	17.45	45.63	44.98	45.37

[1]Calculated using currency exchange rates published in the *Wall Street Journal* on August 31, 1987.

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CURRENT MARKET DATA

CONVERSION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	per lb. U as UF_6			per kg. U as UF_6		
	This Month (Aug 31, 1987)	Last Month (Jul 31, 1987)	12 Months Ago (Aug 31, 1986)	This Month (Aug 31, 1987)	Last Month (Jul 31, 1987)	12 Months Ago (Aug 31, 1986)
Australia (dollar)	2.67	2.72	3.12	5.89	6.00	6.88
Belgium (comm. franc)	71.62	72.91	80.47	157.89	160.74	177.42
Canada (dollar)	2.50	2.53	2.64	5.52	5.58	5.83
EEC (ecu)	1.67	1.70	1.85	3.68	3.75	4.09
Finland (markka)	8.36	8.55	9.33	18.43	18.85	20.57
France (franc)	11.49	11.71	12.77	25.34	25.82	28.15
FRG (mark)	3.44	3.52	3.90	7.59	7.77	8.59
Italy (lira)	2,493	2,550	2,685	5,496	5,621	5,919
Japan (yen)	269.69	283.88	296.32	594.57	625.84	653.27
Netherlands (guilder)	3.88	3.97	4.39	8.55	8.75	9.67
South Africa (rand)	3.87	3.94	4.91	8.53	8.68	10.82
Spain (peseta)	231.79	240.17	254.11	511.01	529.49	560.22
Sweden (krona)	12.12	12.28	13.14	26.71	27.08	28.97
Switzerland (franc)	2.84	2.92	3.14	6.25	6.44	6.93
UK (pound)	1.16	1.19	1.28	2.56	2.63	2.83
US (dollar)	1.90	1.90	1.90	4.19	4.19	4.19

SWU VALUE AND UF_6 VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	SWU Value delivery within one year (Aug 31, 1987)	UF_6 Value per kg.U in UF_6 This Month (Aug 31, 1987)	UF_6 Value per kg.U in UF_6 Last Month (July 31, 1987)
Australia (dollar)	105.46	66.08	68.02
Belgium (comm. franc)	2,827	1,772	1,823
Canada (dollar)	98.84	61.93	63.28
EEC (ecu)	65.83	41.25	42.50
Finland (markka)	329.96	206.77	213.77
France (franc)	453.72	284.33	292.84
FRG (mark)	135.87	85.14	88.07
Italy (lira)	98,399	61,664	63,741
Japan (yen)	10,646	6,671	7,097
Netherlands (guilder)	153.12	95.95	99.18
South Africa (rand)	152.75	95.72	98.44
Spain (peseta)	9,150	5,734	6,004
Sweden (krona)	478.32	299.74	307.04
Switzerland (franc)	111.94	70.14	72.98
UK (pound)	45.91	28.77	29.78
US (dollar)	75.00	47.00	47.50

[1]Calculated using currency exchange rates published in the *Wall Street Journal* on August 31, 1987.

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CURRENT MARKET DATA

RECENT TRANSACTIONS[1]

Uranium Sales

Nuexco Transaction Number	Delivery Period	Approximate Quantity (thousands of pounds, U_3O_8 equivalent)	Approximate Price Range as Percent of Current Exchange or UF_6 Value[2]	Seller	Buyer	Remarks
4135	1987	101-300	R[6]	Producer	R[6]	US-Origin
4136	1987	301-600	98-102	Producer	Utility	UF_6
4144	1988	101-300	98-102	Intermediary	Utility	US-Origin UF_6
4146	1989	301-600	108-112	R[6]	Utility	UF_6
4147	1987	less than 50	98-102	Producer	Intermediary	US-Origin
4148	1987	101-300	103-107	Intermediary	Utility	US-Origin

Conversion Services Secondary Market Sales

Nuexco Transaction Number	Delivery Period	Approximate Quantity (thousands of pounds, U equivalent)	Approximate Price as Percent of Current C.V.	Seller	Buyer	Remarks
4131	1987	101-300	R[6]	Intermediary	R[6]	

[1] Transactions listed are not limited to those in which Nuexco was involved, but also include others of which Nuexco is aware.
[2] Where US-origin material is involved, the range is based on the Exchange Value (or UF_6 Value) *plus* the premium (relative to the Exchange Value or UF_6 Value).
[3] If tails assay is unknown or unspecified, Nuexco's calculation of SWU quantity assumes 0.30 w/o tails assay.
[4] Prices are usually normalized to 0.3 % tails assay.
[5] Refers to SWU Value that corresponds to SWUs included in transaction. When prices and SWU values are expressed as discounts (e.g., X dollars less than DOE's USEC base price at time of delivery), the percentage refers to the ratio of the discounts, not the ratio of the prices.
[6] The notation R means that Nuexco either does not know, or that Nuexco has restricted that information to protect client confidentiality.

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Enrichment Services
Secondary Market Sales

Nuexco Transaction Number	Delivery Period	Approximate Quantity[2] (thousands of SWU)	Approximate Price[3] as Percent of Current SWU Value[4]	Seller	Buyer	SWU Origin	Remarks
4140	1988	101-300	R[5]	R[5]	Utility	USSR	
4142	1987	less than 50	93-97	Utility	Intermediary	DOE	

[1]Transactions listed are not limited to those in which Nuexco was involved, but also include others of which Nuexco is aware.
[2]If tails assay is unknown or unspecified, Nuexco's calculation of SWU quantity assumes 0.30 w/o tails assay.
[3]Prices are usually normalized to 0.30% tails assay.
[4]Refers to SWU Value that corresponds to SWUs included in transaction. When prices and SWU values are expressed as discounts from a reference price(e.g., X dollars less than DOE's USEC base price at time of delivery), the percentage price range is based on the discounted price, not on the reference price.
[5]The notation R means that Nuexco either does not know, or that Nuexco has restricted that information to protect client confidentiality.

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CURRENT MARKET DATA

URANIUM SUPPLY
(August 31, 1987)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Spot or Near -term[2]	Intermediate or Long-term	Remarks
Available for Sale:			
ACTIVE			
87-1002	270	—	
87-1014A	720	—	UF_6
87-1022	40	—	
87-1023	500	500 per year	1988-90
87-1053*	100	500	1988 on
87-1061*	500	500 per year	1988
87-1079*	100	—	
87-1091*	1,000	1,000	UF_6
87-1097*	500	—	
87-1001	—	400 per year	1989 on
87-1005	—	400 per year	1988-95
87-1068	—	325	1988
TOTAL:	3,730		
INACTIVE			
87-1017	1,000	—	
87-1047*	500	—	UF_6
87-1055*	250	300 per year	1988-93
87-1059	120	—	UF_6
87-1019	—	600 per year	1988-91
87-1025*	—	250 per year	1988 on
87-1062*	—	100 per year	1988-89
TOTAL:	1,870		

*New or revised since last month.
[1]Measured from the date of this Report.
[2]For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.
Projects removed since last month: 2168, 2297, 2764B, 3123, 3168.

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URANIUM DEMAND
(August 31, 1987)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Spot or Near -term[2]	Intermediate or Long-term	Remarks
Inquiries to Purchase: ACTIVE			
87-1030	175	—	
87-1070*	600	—	
87-1078*	200	—	
87-1082*	200	—	
87-1092*	200	—	U_3O_8 or UF_6
87-1095*	650	—	UF_6
87-1013	—	1,200 per year	1990-95
87-1021	—	675 per year	1992 on
87-1049	—	700 per year	1989, 91, 94, 96
TOTAL:	2,025		
INACTIVE			
87-1007	150	—	
87-1040	300	300	1989
87-1048*	50	—	
87-1057*	250	—	UF_6
87-1073*	800	—	
TOTAL:	1,550		

*New or revised since last month.
[1]Measured from the date of this Report.
[2]For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.
Projects removed since last month: 2893C, 2962, 3137, 3152, 3220.

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CURRENT MARKET DATA

CONVERSION SUPPLY AND DEMAND
(August 31, 1987)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U as UF_6) Within 3 Years	Beyond 3 Years	Remarks
Available for Sale:			
ACTIVE			
87-1008	750	750	
TOTAL:	750	750	
INACTIVE			
1084C	120	—	
TOTAL:	120		
Inquiries to Purchase:			
ACTIVE			
87-1072	440	—	
TOTAL:	440		

*New or revised since last month.
[1]Measured from the date of this Report.
Projects removed since last month: 3165.

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LOAN SUPPLY AND DEMAND
(August 31, 1987)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Within 1 Year	Beyond 1 Year	Remarks
Available for Loan:			
ACTIVE			
87-1064	600	—	
TOTAL:	600		
INACTIVE			
87-1012	2,000	—	
87-1031*	1,000	—	
87-1033	1,000	—	
87-1071*	1,000	—	UF_6
TOTAL:	5,000		
Inquiries to Borrow			
ACTIVE			
87-1098*	100	—	UF_6
TOTAL:	100		

*New or revised since last month.
[1]Measured from the date of this Report.
Projects removed since last month: 1938, 2036, 2909.

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CURRENT MARKET DATA

SWU SUPPLY AND DEMAND
(August 31, 1987)

Nuexco Project Number	Delivery Period[1] (Thousands of SWU) Spot or Near-term[2]	Intermediate or Long-term	Remarks
Available for Sale:			
ACTIVE			
1096	150	—	1988
1068*	100	—	1988
TOTAL:	250		
INACTIVE			
87-1004	55	—	1987
87-1058	50	—	1987-88
87-1059	25	—	
TOTAL:	130		
Inquiries to Purchase:			
ACTIVE			
87-1024	25	—	1988
87-1087*	15	—	1988
TOTAL:	40		
INACTIVE			
87-1042	30	—	
87-1065*	150	—	1988
TOTAL:	180		

*New or revised since last month.
[1]Measured from the date of this Report.
[2] For delivery within one year. This category excludes SWU deliverable within one year under other than spot or near-term contracts.
Projects removed since last month: 3173, 3159, 3213.

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ESSAY

A NATIONAL STRATEGY FOR NUCLEAR POWER IN THE USA

By J. Robert Wolcott
Chairman, Nuexco/Concord International
Advisory Committee

Mr. Wolcott, the former Chairman of Nuexco, is now Chairman of the Nuexco/Concord International Advisory Committee. Mr. Wolcott's views, as outlined in this essay, are set forth to stimulate thought and discussion, and do not necessarily represent those of Nuexco.

In this essay, Mr. Wolcott presents four main points that are substantial departures from most current thought in the nuclear industry.

First, efforts to change the existing regulatory system will have only limited benefits; the industry must accommodate the market and face the deeply-rooted psychological patterns and social conditions that are not likely to quickly change. New conceptual approaches, both to nuclear plants and to plant siting, are needed to better align the industry with today's electricity market, and the markets as they will probably be in the future.

Second, nuclear power must capitalize on its greatest asset, which is its inherent environmental advantage over most other generating technologies. Focusing public attention on the need for additional electric power supplies and on the advantages of nuclear fuel supply security have not changed public attitudes enough to bring about a resurgence of the US nuclear industry.

Third, if present trends continue, we should not expect renewed nuclear construction. But new construction is vital for many reasons. The best means of beginning new construction is through a prototype program, which would result in new standardized, licenseable light-water reactors and would evaluate newer technologies for possible use in the future.

Fourth, a realistic approach to the market would necessarily involve many changes in organization of the nuclear industry, including redefined roles for reactor vendors, government, and utilities.

Introduction

More than 30 years have passed since the beginning of commercial nuclear power in the USA. The first half of that period was largely a string of successes, while the second half has been largely a string of setbacks. After construction of more than 100 power plants, producing over 16 percent of the nation's power, expansion has stopped and no renewal of construction is in sight. What to do to revive the nuclear industry, and who should do it, are matters of national importance. Leadership in the field of nuclear power was once considered essential by the US government, among others. Nuclear power was an important instrument to achieve national technological and economic objectives.

For example, the Atoms For Peace Program, begun under the Eisenhower Administration, assumed that US leadership would be essential to control the proliferation of nuclear weapons. Policies were shaped accordingly. Within the past fifteen years, however, utilities and government in the USA have ceased new construction, terminated reprocessing, imposed unilateral political conditions on nuclear fuel supply, and are no longer working at the leading edge of most nuclear technologies. France and Japan are now supplying the driving forces that mean future leadership.

US electrical energy needs, growing 3 percent per year, will soon require as many as 15 to 30 large new electric power plants each year. Existing plants are aging and the rate of new construction is insufficient to provide replacements. Although a balance of excesses and shortfalls in regional capacity has allowed delaying new construction, much of the potential available from such an increase in utilization efficiency has now been used. The limitations of renewable sources are such that they cannot yet contribute in a major way. Environmental concerns over the use of fossil fuels are increasing. In short, the USA is postponing solutions to its imminent problems until some future date.

A widely accepted belief is that nuclear power will eventually be essential to the USA. A strategy is needed that will connect the US policy position with what will eventually allow a much greater utilization of nuclear energy. But such a strategy requires that we ask, and answer, many questions. What are the implications of the USA accepting a progressively declining world role in nuclear technology, in which the dominant leadership is assumed by others? Will nuclear power be seen as a solution to fossil power plant air pollution? Should the USA rely on present designs, siting concepts and regulatory approaches for the

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future? What is the US policy on standardization? Who will take the lead where government, industry, and the public are concerned? Answers to these questions are overdue.

New Conditions

When the nuclear industry began in the 1950s, it was supported by a non-hostile public attitude, a government fully ready to undertake nuclear programs for domestic and international reasons, utilities willing to participate, and businesses willing to invest. New power plants were generally welcomed by communities. Waste disposal was not an issue. It was an article of faith that scientists and engineers would solve whatever problems emerged from nuclear technology. All of that has changed, and any strategy for the revival of the US nuclear industry must grapple with those changes.

The most important change of the past 15 years has been the extreme politicization of energy. The oil crises, in particular, highlighted the impact of energy policies on national security, the economy, and foreign relations. Energy costs pitted consumers against producers and increased the government's role as an arbitrator. The newly discovered importance of energy technology and policy attracted increased interest from a whole range of academicians, philosophers, lawyers, media specialists, scientists, consumer advocates, and others. Various "experts" promoted solutions to energy-related problems ranging from the practical to the ridiculous, and most of the proposed solutions carried a strong political content. Politicization moved decision-making from the realm of economists, managers, and engineers, to the political arena. Tax incentives, regulations, and various types of self-interest became more important than simple economics.

Public acceptance has become a much more important consideration. The public now demands worry-free operation with safety assurances beyond those considered necessary on technical grounds. Shipments of radioactive materials, once carried out routinely, are increasingly resisted by communities and states. "Pro-environment" positions often gain widespread public and government support, even when scientific proof is lacking. Businessmen understand all too well the perils of ignoring the true market, which is always a combination of economic, technological, social and psychological factors.

The Forces of Deregulation

Twenty years ago each utility, with few exceptions, provided its own generation, transmission and distribution facilities within prescribed geographical areas. Conditions gradually changed as power plants were located near fuel sources (particularly fossil-fuel sources) and economies of scale encouraged large plants whose generating capabilities often exceeded the needs of production for a single area, and could be used to produce for another. Regional barriers which once existed began to weaken as utilities focused on integration and supply to larger markets than those which they had previously known.

At the same time, interest in the benefits of increased competition has been growing. The trend toward increased deregulation is shaping a modified incentive structure with a strong competitive emphasis. For example, Commonwealth Edison is proposing a separate generating company owning several nuclear plants. San Diego Gas and Electric announced its intention to concentrate on distribution and the purchase of bulk power from others. Bechtel proposed formation of an operating company to include nuclear plants owned by several utilities.

Separately-owned transmission lines are under consideration. Cogeneration facilities owned by industries other than utilities are providing power to certain users, and are increasing rapidly in importance. Numerous other small suppliers are seeking access to the power generation market. The forces favoring deregulation exist not only on an ideological level at the top of the federal government, but also at lower levels in the form of small-scale operators.

Deregulation need not apply evenly to generation, transmission, and distribution. The potential for competition is different with each. Bulk electricity can be sold competitively. Transmission may, or may not, be competitive, depending upon local circumstances, and regulation probably would be necessary to preclude "toll gate" monopolies. Competition for local distribution is probably impractical because duplicate facilities may be impractical, and regulation may continue much as it is. Separate incentive and regulatory structures would need to be designed for each segment of the electricity market, and operations to fit those structures would naturally evolve.

Such changes would not occur all at once, but rather would take place step by step in many separate utilities regulated by separate agencies of government. The pace

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will not appear revolutionary. Nevertheless, the cumulative impact by the end of the century will be substantial.

The Role of Government

Thirty years ago, when nuclear power's advancement was believed vital, the government organized for action. A Joint Committee for Atomic Energy (JCAE) was comprised of members of both houses of Congress, and the US Atomic Energy Commission (AEC) focused all nuclear activities within the Executive branch. The centers of power were clear, and they cooperated effectively. Then, about 15 years ago, when strong government direction was most needed, nuclear energy functions were totally reorganized. The JCAE was dissolved and its functions were assigned to a variety of committees and subcommittees. The AEC also was dissolved and its functions were assigned to a newly formed Nuclear Regulatory Commission (NRC) and to various parts of what is now the Department of Energy (DOE). In effect, the government's nuclear energy administration decapitated itself.

The need for a strong government role did not change with the reorganization, nor has it lessened because of a declining nuclear program. A strong government role is needed today even more than before, in order to meet a stronger challenge. The challenge is only partly that of managing an ongoing policy program; the other part requires reestablishing a virtually defunct industry. That will be no less difficult than the initial establishment of the industry.

The Advent of Standardization

Industry-wide plant standardization has never been a major goal of most US utilities. Most have valued their independence and have pursued separate designs according to individual company interests. While this type of individualism worked well for fossil-fuel and hydropower systems, the needs of nuclear systems have proved quite different, because they are much more complex. Five Nuclear Steam Supply System (NSSS) vendors existed in the USA at one time. Over a dozen architect-engineers and numerous construction contractors and subcontractors participated in building the nuclear industry in the USA. Each organization added its own way of doing things, and a variety of designs, construction techniques, safety provisions, and operating systems resulted. Reviews of all those individual systems, most of which were singular designs, overwhelmed the NRC. Design requirements escalated as the best aspects of each design became a standard for all other designs.

France, currently the country with the most successful nuclear program, has extensive standardization. Nuclear plants in France are built under a single owner, the national utility Electricite de France (EdF) and a single NSSS vendor, Framatome. EdF controls plant design, construction, and operation. Equipment suppliers and construction contractors enjoy repeated contracts, and so are able to apply and reapply their experience. Operator training also is standardized, and operators can move from one plant to another with little difficulty.

While the US nuclear industry has not established standardization policies, because no new projects are in process, a consensus is forming that standardization is desirable and inevitable. The single utility French model is impractical in the USA, but many of the French principles could be used. The number of approved designs could be limited to two, and the industry could be structured around that number.

Environmentalism As A Force

The most important single political and social force affecting energy production in the USA is that of environmentalism. The nuclear industry has received only a fraction of the credit it deserves as a positive force for environmental progress. In fact, the reverse seems to be true, for it has received a great deal of undeserved discredit. Nuclear power's greatest advantage comes from the waste disposal options provided by the fission process, and this asset has been turned into one of its its greatest political liabilities.

In the combustion of fossil fuel, matter is only changed in form. The weight of the waste, whatever the form, must equal the weight of all materials used in the combustion process, such as the combination of coal and air. Because a large coal plant may burn a million pounds of coal per hour and uses vast quantities of oxygen in the process, the total mass of waste greatly exceeds the mass of the coal. Roughly 15 percent remains in the form of ash while the remaining 85 percent is discharged into the atmosphere as gas, which creates smog, acid rain, the greenhouse effect, and other problems. In reality, burning fossil fuels only takes solids from the earth and puts most of them into the air as gases.

In the fission process, comparatively miniscule amounts

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of material are converted into enormous amounts of energy. Several thousand pounds of fissionable material are enough to fuel a large plant for a year and will produce a roughly equivalent amount of waste, not the millions of tons produced by, for example, a coal-fired plant. There are, of course, different forms of waste, such as irradiated materials and fission products, but they can be contained using well-developed and easily-applied technology.

The critically important difference between the two processes is that the volume of waste associated with the burning of fossil fuels makes containment and control impossible. It must be released to the environment either as a gas or solid. Mechanical and chemical aids, such as scrubbers, can lessen the degree of atmospheric pollution, but these are only partially effective. Volumes of fission products, on the other hand, are sufficiently small that, even though they are highly radioactive and difficult to handle, they can be kept virtually under man's permanent control. They need never be released into the environment.

The two types of available technology, nuclear and fossil-fuel, provide a fundamental environmental choice. The public must decide whether its interest is best served by releasing large volumes of waste into the atmosphere or by retaining and monitoring small volumes of waste on earth. The choice is obvious, but that obvious choice has not been made.

Prevailing public attitudes will be difficult to change. Nevertheless, facts can displace myths. Not all people interested in the environment are of a single mind. At one fringe are the highly-visible extremists, who have co-opted the "environmentalist" title in the name of a "return to nature", anti-progress, anti-technology philosophy. It is unlikely that much change in the attitude of that segment will be achieved, although it is not impossible and should not be ignored.

The more important group is also a much larger group. This group consists of citizens with environmental interests based on ethics related to cleanliness, aesthetics, conservation, and so forth. They possess an ingrained ethic much like the work ethic. A large part of this group consists of educated professionals who can readily understand the difference in consequences between the use of fission and fossil-fuels for power generation.

The two groups — the messianically-oriented one on the one hand, and the ethic-oriented one on the other — derive their views and visions from fundamentally different assumptions. They will consistently differ on national defense, welfare, and many other issues. But they all agree upon a need for a clean environment. It is this parallelism of views that makes the support or opposition of the "environmentalists" the most comprehensive single force in the USA today affecting the future of nuclear power. Industrial and population growth make it difficult to provide solutions that keep up with or anticipate the growth of problems. Public support for ever-increasing new government regulations has no limit in sight. The nuclear industry's challenge is to flow with that tide. Fortunately, I believe, the nuclear industry has the ability to accommodate that force.

Project Management, Systems Design, and Operation

The early turnkey nuclear power plant projects managed by General Electric and Westinghouse were completed in five years or less at a fraction of today's costs. With expansion, project management shifted to utilities and engineer-constructors and the industry's growth greatly increased the difficulties of building nuclear plants in a reasonable time and at a reasonable cost. Design changes, due in large part to increasing regulatory requirements, overwhelmed the system. Construction schedules lengthened and costs rose. Projects changed from fixed-price to cost-plus contracts. Public utility commissions applied the "prudent man" test with hindsight. Benefits from "prudent" management were often passed to consumers while costs from "imprudent" management were passed to shareholders. .

System design became more difficult as the pace of change increased. The NSSS design was provided by one of several US suppliers, and the balance-of-plant design was provided by one of a number of architect-engineers. As integration of all those affected by design changes became more difficult, it became apparent that a single-system design organization, such as that used by Kraftwerk Union (KWU) of West Germany, Asea-Atom of Sweden, and Toshiba of Japan, had important advantages.

The quality of the plant's operating staff makes major differences in operating results of all types. Utilities operating under similar circumstances and with similar plants have shown remarkably different results. Nuclear technology is "human intensive" and requires many highly trained specialists. A well-staffed organization is most readily attainable by multiple-plant operations. To be sure, size is

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no guarantor of success. But on the whole, the type of technological complexity found in the nuclear power industry is usually best served by balanced organizations large enough to support the full range of specialists.

Responding to New Conditions

Current conditions are quite different from when the concepts now in use were developed. Though some problems remain, a vast amount of light-water reactor experience is available. Other nations' approaches are available for comparison. Two major accidents, one American and one Russian, have occurred and have altered public perceptions about siting plants close to populated areas. Public concerns over nuclear safety require that those matters be dealt with realistically. Radioactive materials are becoming more difficult to ship and further transportation difficulties may be in store. The role nuclear power may play in nuclear weapons proliferation is of concern to some. The way the industry is organized is shifting and could change radically within the next 20 years. Better and more specialized nuclear management is required. One must look beyond these conditions for electrical generation investments over the next 50 years.

One conventional assumption is that an energy crisis which "turns out the lights" will force a resolution of the nuclear dilemma. In theory such a crisis will result in a consensus between government and the public, giving the government a clear mandate for more nuclear power. Under this strategy we need only wait for that shortage, which many expect to be inevitable, to have a resurgence of nuclear construction. When the crisis occurs, the technology that is already available can be taken off the shelves and put to use.

This is not realistic. When the need does develop we are likely to find that the existing solutions do not match the problem. The nuclear industry will again fail to understand the market. A crisis that significantly affects the public quickly becomes a political problem, but political pressures produce short-term trade-offs rather than attention to long-term solutions. An electrical shortage would probably result in rationing (probably disguised as "conservation"), rapid construction of gas turbine facilities, and other expediencies.

Nuclear power can only become a solution when we are able to plan for the long-term needs of the nation. Some people believe that even without a crisis, the nuclear industry will return to health because of its economic advantages and the obvious benefits of using uranium to supplement a limited fossil fuel supply. Nuclear power had a clear economic advantage for at least a decade, and continues to have an advantage in many areas. In spite of this advantage, the industry has declined. If nuclear power can command the strong support of the environmental movement, as it is so well suited to do on technical grounds, a new beginning is not only possible, but probable. The combined factors of favorable environmental impact, increased energy security, and advantageous economics, in that order of priority, should produce results. But what sort of industry may be suitable for conditions as they now are and as they are likely to be? What can we envision?

Generating Companies and Nuclear Parks

The trend towards deregulation, the need for remote siting, the difficulty of obtaining new sites of any type, and the need to make sites self-contained all indicate that nuclear parks may be a desirable solution to nuclear siting problems within the next 20 years. These parks would require a tremendous investment, well into the tens of billions of dollars, but they could concentrate on power production under specialized managements, specifically trained for nuclear operations.

For purposes of illustration, one can envision a multiple-plant nuclear park, with its ownership formed exclusively for producing and selling bulk power to customers located throughout a entire region, such as the western USA. Various forms of ownership might be used, such as a publicly-owned company, or a joint venture of one or more utilities. Regulation might be applied more at the federal level than is currently the case. The company would sell its power in competition with other power-generation entities, including other parks, cogeneration operators, and small and large suppliers of other types.

A high degree of site integration with the back end of the fuel cycle is essential. On-site facilities would provide a number of fuel-cycle operations, such as reprocessing spent fuel, recycling remaining fissionable products as fuel, isotope separation, and packaging and storage of waste. The purpose of these facilities would be to make shipment of radioactive materials from the site unnecessary for many years. As the nuclear park would be large, isolated, self-sufficient and integrated, it might resemble in

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many respects the early Hanford and Savannah River installations. Its location would create minimal community disturbances, and, as in France and Japan, tax and employment benefits could be used to advantage.

Such nuclear power stations would have safety features that go beyond those used today, including "inherently safe" designs (that is, a conditional self-shutdown of power and the avoidance of possible core meltdown). Reactor designs would be of a standardized type, proven by large-scale prototype testing. Large operations such as this would have to develop more in-house capability in design integration, project management, and training. Deregulation might permit the acquisition of industrial support companies that would not now be allowed

New Requirements for Government

The government needs improved nuclear licensing procedures. Past practices have strangled the industry without increases in nuclear safety. Improvements are needed not only for continuing operations but also for new projects, but improved licensing alone will not motivate new construction. Assurances that the government may provide at one point in time can be taken away at a future point in time. The owners and managers of nuclear utilities have to take the long view, and that includes evaluating the risk of potentially adverse, retroactive government decisions.

The nuclear industry needs the following from the government:

1. Research and development funding is essential to develop new technologies, including increased emphasis on the back end of the fuel cycle.

2. The government must fund a portion of the cost of a prototype program, where the cost exceeds the value to be recovered from electricity production. Extra costs will result from the prototypes' sub-optimal size, and from component and plant testing.

3. The government must be made financially accountable for the potentially adverse effects of government decisions. For example, if the government imposes costly regulatory requirements after a project's approval, government funds should compensate for the consequences. Although from the government's point of view there are difficulties associated with such guarantees, the difficulties associated with costs to the shareholders are greater.

4. Binding agreements must be signed with public utility commissions and other regulatory bodies at the start of a project, to avoid after-the-fact "prudency tests." Prudency must be considered at the time decisions and forecasts are made, and must apply to public utility commissions as well as to owners.

Congress will not easily provide government assurances for new nuclear prototype development. Public opinion must assure that such actions will be viewed as politically positive ones rather than negative. Considerable time will be required for this kind of public pressure to build, and it is most likely to come from environmental concerns.

Changing NSSS Supplier and Architect-Engineer Roles

Standardization, centralized project control, integration of systems design, and expanded utility capability will force changes in the roles of NSSS vendors, architect-engineers, and service companies. Especially if new, larger generating companies are formed the utilities will tend to expand their scope at the expense of others. Standardization also will necessarily reduce the number of participants. Limiting reactor designs to two standardized types, for example, would suggest no more than two NSSS vendors (if they remain as suppliers). Architect-engineers might be similarly limited.

Because of new conditions, it is not clear what form a supplier industry might take. One can envision the possibility of one or two companies similar to Asea-Atom of Sweden and Kraftwerk Union of the Federal Republic of Germany, which provide integrated design, construction, installation, and start-up capabilities. An integrated company in the USA could be formed around a major construction firm, such as Bechtel, or a major generating company might establish a supply company which not only would serve its own needs, but those of others as well. What does seem likely, in any event, is a less fragmented industry.

A Transition Solution: A Prototype Demonstration Program

US nuclear designs were largely conceived in the 1960s. A market mismatch obviously exists, for those designs are not accepted in the USA and a newly-active nuclear market may not emerge for 10, 20, or even 30 years. Even so, there is a need to maintain some continuity in US nuclear energy capability, to keep the USA at or near the forefront of technology and to have proven, tested, acceptable new

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designs available when they are once again needed. How can the industry survive this transition period? The best mechanism appears to be a prototype program. No other alternative even appears possible; it seems most unwise to assume that utilities will soon again be building nuclear plants, and even if they do, a prototype program still would be advantageous because normal construction may not provide the needed advancements.

A successful prototype program would have several objectives:

1. To design, build, and test models which would meet projected social and technical safety requirements;
2. To develop self-sufficient systems appropriate to the "nuclear park" concept;
3. To update our vast experience in light-water reactor technology and to translate that experience into licenseable, standardized designs available for use within ten years;
4. To construct light-water reactor prototypes, and possibly other types, that would be suitable for long-term commercial electrical generation following testing.
5. To evaluate advanced technologies.

Composition of the Prototype Program

I suggest four reactor prototypes and one fuel-cycle development facility as an appropriate program. The four reactors would consist of two light-water reactors, one Integral Fast Reactor, and one High-Temperature Gas Reactor.

The proposed light-water reactors would be in the 300 to 600-MWe range. They would be designed with inherent safety and whatever additional safety features are needed to ensure public acceptance. They would be compatible with fuel cycle developments. All designs would be expandable for larger sizes.

The Integral Fast Reactor prototype would be smaller, possibly 50 to 150 MWe. That reactor is said to possess simplicity, inherent safety, features which make diversion of fissionable material difficult, and the capacity to use reprocessed and recycled fuel and waste as part of the total system. It appears to have many attractive features, and if the claims prove valid, a prototype to produce a licensable design would be the next logical step.

Government and industry have supported high-temperature gas reactor technology programs costing approximately $30 million per year for some time. Many in the nuclear industry believe that this type of reactor has significant potential safety and economic advantages. The prototype program would utilize the research and development results and evaluate the advantages and disadvantages. A size similar to that for the Integral Fast Reactor, or 50 to 150 MWe, would be logical. If results merit continued work, the next step would be a larger prototype and a program similar to those proposed for light-water reactors. In addition, the fuel cycle project would develop miniaturized reprocessing, recycling, isotope separation, and waste handling processes useable with all types of reactors.

Financing

The cost of the five projects probably would be in the range of $4 to $6 billion, or roughly equivalent in magnitude to DOE's Superconducting Supercollider project. Overall, its value for purposes of electricity generation may be $2 to $3 billion. This suggests that financing could be accomplished partly by operators interested in electrical production, partly by utilities benefiting from the later availability of advanced nuclear power designs, and partly by the government for its different reasons. The government and utility portion may amount to 2 or 3 billion over about 15 years, so that annual costs would be about 150 to 200 million per year, not a large sum compared to present expenditures.

Use of The Idaho National Engineering Laboratory Site

A test station now exists which would adequately, and perhaps ideally, suit the prototype program: the Idaho National Engineering Laboratory. The Laboratory has a long history of testing naval reactors and training personnel, and it has experimentally tested small light-water reactors and fast-breeder reactors, including the Integral Fast Reactor. The operation has the support of the surrounding community and every level of state government. A trained and experienced work force of 10,000 is performing work similar to that which would be required for prototypes, which could be tested side by side and under common circumstances. Support facilities also are available for these types of activities. Electricity could be exported to the Northwest, West, and Southwest. Using such a site might also eliminate the lengthy investigation and negotiation that often accompanies major nuclear projects. Comparable sites might also be found at Hanford and Savannah River, although neither appear to offer assets comparable to those of Idaho.

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Some Near-Term Actions

A number of near-term actions should be taken to support a prototype program and to turn the declining US position around.

1. We must develop a clear, specific picture of nuclear plant ordering requirements, as we anticipate them to exist around the year 2000. The result would be the equivalent of a product planning specification, and would define characteristics for prototypes and identify research and development needs.

2. We must define the prototype program in detail. We must formulate specific roles for government, utilities, and others and develop a practical funding plan.

3. We should prepare conceptual designs for a nuclear park, and use them to aid development of specifications and for public relations. The public tends to think that nuclear power has reached the limits of its technology, that what has been done is all that can be done. The nuclear industry needs to show that the limits of technology have not been reached and that new and exciting possibilities lie ahead.

4. We must define the government's role if it is to allow our industry to move ahead. Specifically, under what conditions would a progressive utility or other nuclear company be able to move forward.

5. We must formulate a public relations program whose priorities emphasize nuclear power's intrinsic environmental advantages and aesthetic possibilities (including the possibility of underground construction). Priorities in public relations should be in this order: (a) environmental advantages, (b) futuristic conceptual designs based on possible advancements in technology, (c) use of readily available fuel supplies from friendly nations for fuel supply security, and (d) economic advantages.

Summary and Conclusion

One may argue that nuclear power is not dead in the USA, as the more than 100 plants in operation demonstrate. However, operation of existing plants does not mean a strong future US role in nuclear energy affairs. Leadership requires a nuclear program that takes the initiative, so it requires the building of new facilities. Only active projects can result in coherent, realistic programs. Concepts of design, siting and operation used in the past no longer fully apply; they need updating. Active programs must shape the future without expecting to return to the past. There is little, if any, likelihood that utilities will order nuclear plants as part of their normal generating programs until new and different government actions are evident.

The gap in new nuclear construction may last for 10 to 20 years. This gap needs to be filled. Those responsible for national electrical energy supply leadership must initiate a program to fill that gap. A prototype program is an affordable answer. Government assurances will be forthcoming only when and if public attitudes encourage action. Our basic need, therefore, is to focus public attention on matters of the greatest short-term public interest, and particularly those affecting the public's perceptions of environmental, safety, and waste matters. If we apply ourselves to these goals, nuclear power can, and very likely will, experience a resurgence of confidence and activity in the USA.

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PRODUCTIVITY IN US URANIUM MINES

Introduction

In 1973, US uranium mine employees produced an average of 31 pounds of uranium concentrates per manshift. In 1979, that average had fallen to 10 pounds, but by 1983 it had risen to 27 pounds. These variations have primarily been caused by market forces.

During the period 1967-1982, the Grand Junction, Colorado office of the US Atomic Energy Commission (AEC) and its successor groups annually published data on a variety of aspects of the US uranium industry. These data included numerous details of mine production and mine employment from which mine productivity may be calculated for that period. After 1982, the US Energy Information Administration assumed responsibilities for tracking uranium industry data, and modified the format from that used previously. Under the new format, some types of data were no longer published, in particular, distribution of mining employment by mine type and work category. Thus, it is not possible to extend a complete set of productivity evaluations through the period 1983-1985.

Definitions and Background

In any industry, productivity is a measure of labor efficiency, and may be defined as the ratio of output to input. In mining, productivity generally is measured as the ratio of output (in tons) to input of labor (in manshifts). This measure is particularly applicable to coal mining where the mine output is marketed more or less directly, and does not require further processing. Many other types of mining, including most metal mining, produce an ore which contains only a small percentage of the finished commodity. In those cases, productivity can be equated to actual metal output through the tonnage and grade of ore produced. In the case of uranium, the output/metal content relationship is given by the following formula:

$$\text{Output (pounds } U_3O_8) = \text{Tons of Ore} \times \text{Ore Grade (\%}U_3O_8) \times 20$$

Output might also be measured in terms of revenue generated by applying a price to production. In addition to its effect on revenue, price also can have a significant impact on the quantity of reserves available for exploitation, through the mechanism of "cut-off grade." In metal mining, most deposits exhibit a distribution of ore grades, not all of which are economically exploitable. Ideally, "cut-off grade" defines the economic break-even point of production. As prices rise, the cut-off grade is lowered to include material previously classified as sub-economic. Because the distribution of ore grade is lognormal (most mines have greater tonnages of low-grade ore than of high-grade ore) for most trace-metal deposits, small changes in cut-off grade can cause large changes in reserves and, as a consequence, mine life.

The cut-off grade also has a regulating effect on mine profitability. In times of high prices, a mine operator can mine lower-grade ores thereby extending reserves, but production costs, per unit of metal produced, will also be high. The reverse is true during times of low prices.

Technology, both positive and negative, also affects productivity. In this case, positive technology means improvements in equipment and techniques that, in turn, produce greater production efficiency. Examples of positive technology include the expanded use of rubber-tired diesel equipment, high-speed hydraulic-powered drills and raise boring, and the introduction of more efficient ground support systems such as split-set rock bolts. "Negative" technology (in the sense of not contributing to productivity) can include constraints imposed on personnel, equipment and methodologies by management or regulatory bodies for the purpose of improving health, safety and environment. The uranium mining industry has been hit hard in recent years by such constraints. Combined with low prices, the result has been an industry of greatly reduced size. This reduction also has its good side, however, in that new efficiencies are sought out and introduced and old inefficiencies (including people and companies) are phased out.

Price Trends

Price is the constant that affects any analysis of mining cost or productivity. In the short term, price controls marginal cost. In the long term, economists believe that the opposite occurs. The period under review is relatively short in economic terms, and most of the effects shown will relate directly to price.

Spot market uranium prices have shown substantial change during the period 1967 to 1985 from a low of less that $6.00 per pound U_3O_8 in 1972 to a high of more that $43 in 1978, as indicated by the Nuexco Exchange Value. Since any price or cost analysis through time is complicated by the effects of inflation, it is sometimes more useful to

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show prices in constant dollars. In Figure 1, the Nuexco Exchange Value is shown both in constant 1986 US dollars and in historical dollars. Using constant dollars, prices in effect during 1967 to 1974 are similar to the prices from 1982 to 1985 and provide an interesting background for comparison. Constant dollar prices were developed using the Producer Price Index for Industrial Commodities. Most of the graphs presented in this article use a background shading of the constant-dollar price curve to illustrate the effects of changing prices.

Production Trends

US uranium mine production has dropped substantially since 1980, when 40 million pounds of U_3O_8 were produced from 17 million tons of ore. In 1985, US mine production was 6.3 million pounds U_3O_8, from 1.5 million tons of ore. Most of this reduction can be attributed to decreasing prices and to a lack of higher-grade, low-cost resources. Figure 2 shows US mine production of uranium concentrates for the period 1967 to 1985. Historically, most US uranium production has come from underground mines of the Colorado Plateau and the Grants Mineral District. Wyoming has had the major share of open-pit production in recent years, while Texas and Washington have produced smaller amounts.

Underground mining seemed to react slightly more quickly to the price rise of the mid-1970s than did open-pit mining. Overall, however, production response has tended to lag behind price changes by two to three years. By factoring constant dollar prices into the uranium production situation (Figure 3), the full impact of price/production decreases can be seen. It is not surprising from this graph that the US uranium industry has been declared non-viable. The value of the product produced in 1985 was only about 4 percent of the 1978 value, a most discouraging change for the uranium mining industry.

Average mine production ore grades have responded fairly rapidly to changes in price (Figure 4). Recently, the underground mine production ore grade has shown almost an inverse relationship to price, and is the result of the cut-off grade mechanism and the flexibility of production grade in underground mining. The longer-term decline in ore grade from open-pit mines is primarily the result of the time-lag between mine development (stripping of overburden and waste) and the production of ore from the mine. Significant expenditures for open-pit mine development were made during the period of higher prices. By the time much of the ore was uncovered and available for mining, the period of peak prices had passed, but production had been set, in part, according to assumptions of future prices. Of course, much of this production was sold forward under long-term contracts and prices received under these contracts exceeded the spot price. Thus, low-grade ores committed under such contracts could be open-pit mined at a profit.

Employment Trends

Between 1967 and 1985, uranium mine employment peaked at 13,000 in 1979 and then declined to a low of 1,200 in 1985, as shown in Figure 5. This overall employment curve is composed of three primary elements—open-pit employment, underground employment and mine staff employment. As Figure 5 shows, underground employment responded somewhat more quickly to the 1973-1976 price increase than did employment in open-pit mines. This reaction can probably be attributed to less lead-time for the smaller underground mining equipment required for expansion of production.

The overall shape of the employment curve is very similar to that of the price curve, but tends to lag behind price. This may be due to the fact that the majority of production was sold under medium to long-term contracts and, thus, was somewhat price insensitive in the near term downtrend.

Mining operations require a significant number of hourly-paid support personnel for logistics and maintenance. Figure 6 shows the ratio of support personnel to miners for open-pit and underground mines. While open-pit mines show no definite trend, it is clear that support labor requirements in underground mining have increased significantly since 1967. Much of this increase probably can be attributed to an increasing emphasis on health and safety.

Traditionally, a mine staff might have consisted of one or two engineer/surveyors, perhaps a geologist, a purchasing agent, a secretary, and a mine manager, along with a few support staff. Increasing paperwork requirements associated with regulatory permits, health and safety, industrial relations and financial/shareholder responsibilities have greatly increased the ratio of mine staff to mine production employees (Figure 7). This category of employment totaled almost 3,700 in 1979, three times as many staff workers alone as the entire industry workforce in 1985.

Productivity Trends

A recent Swedish study on productivity in underground

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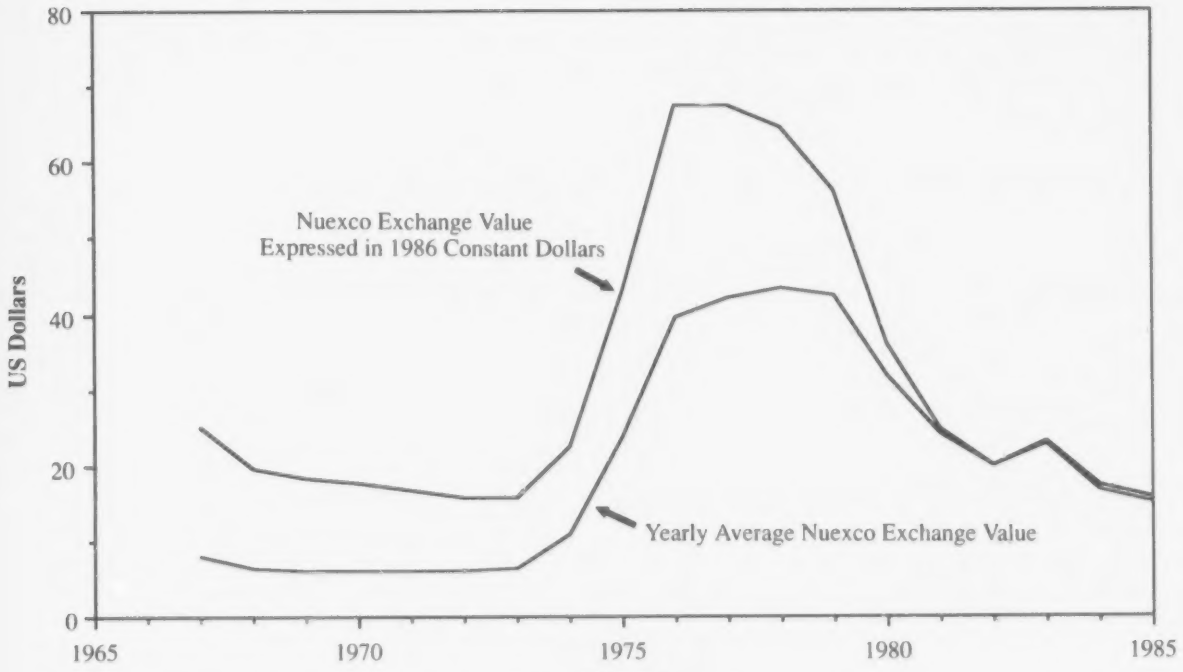

Figure 1
URANIUM PRICES

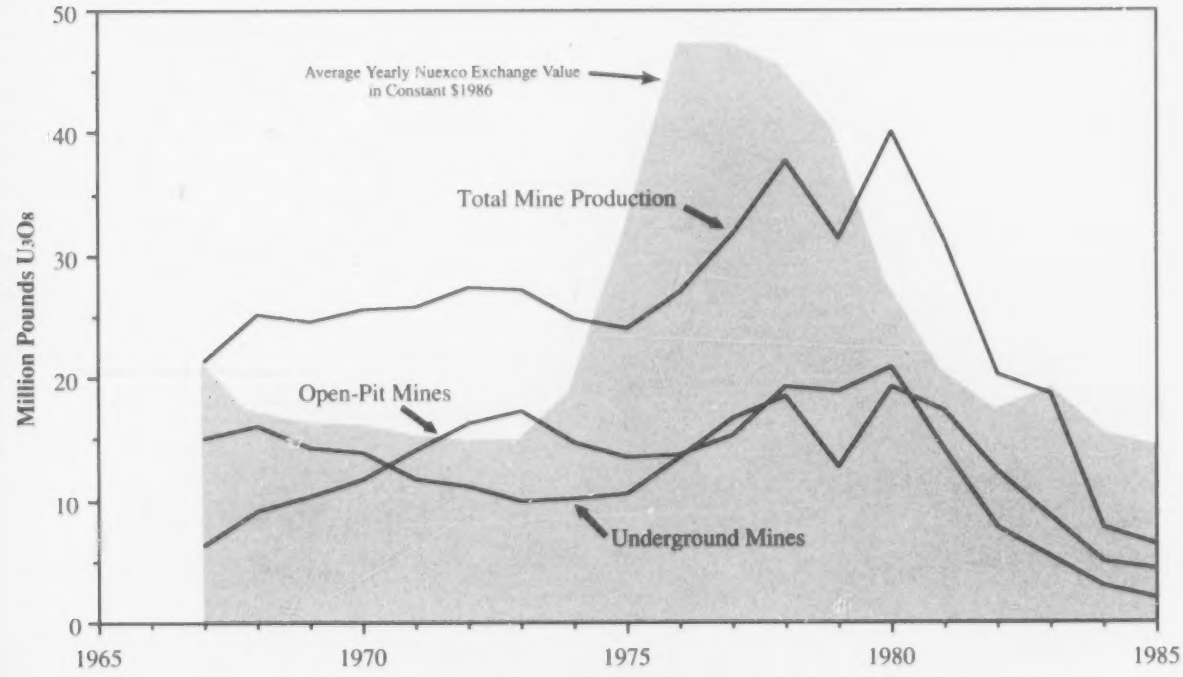

Figure 2
HISTORICAL MINE PRODUCTION

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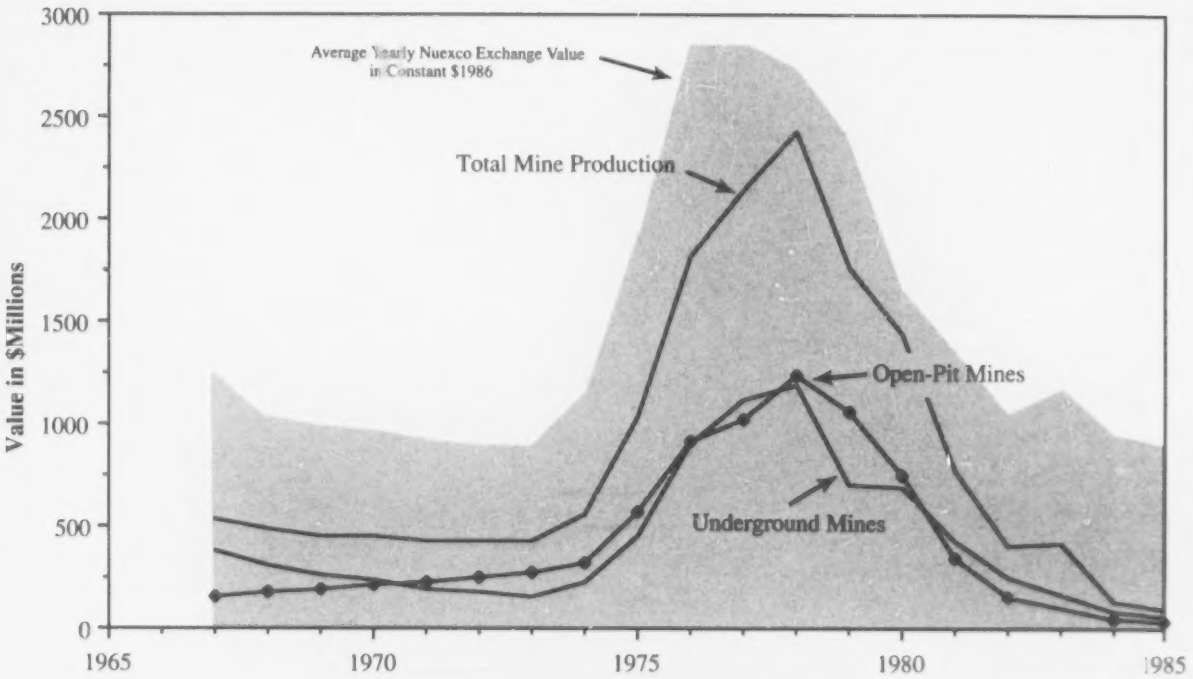

Figure 3
VALUE OF US URANIUM MINE PRODUCTION
(Constant 1986 Dollars)

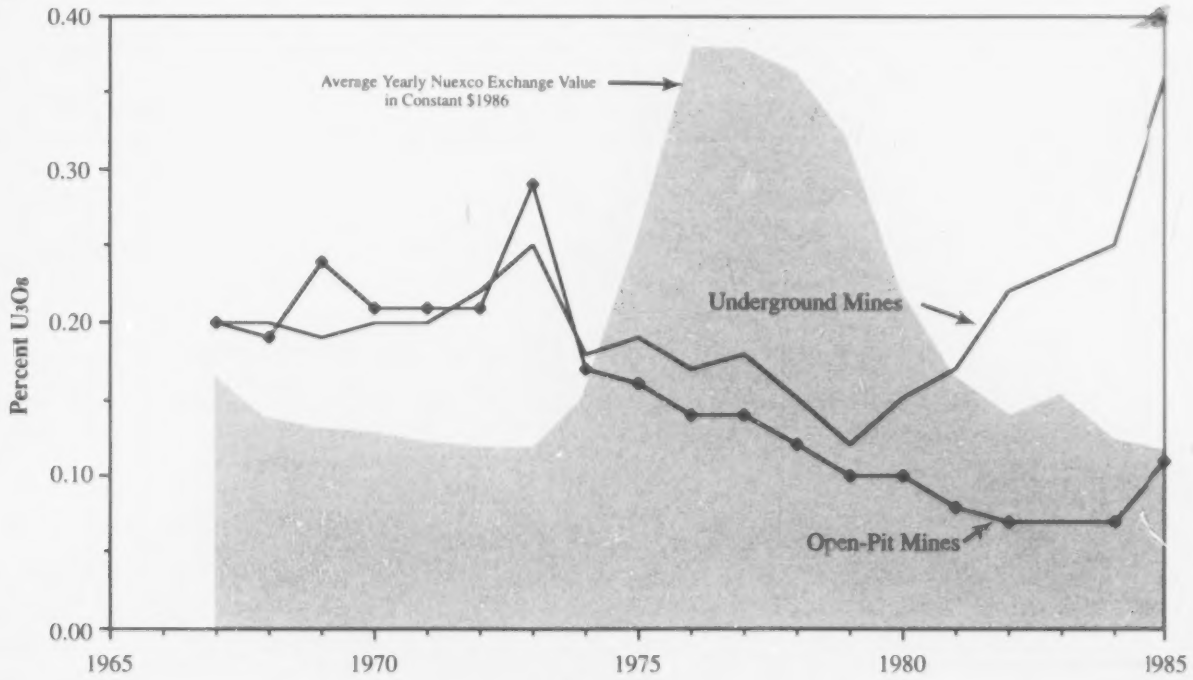

Figure 4
MINE PRODUCTION ORE GRADES

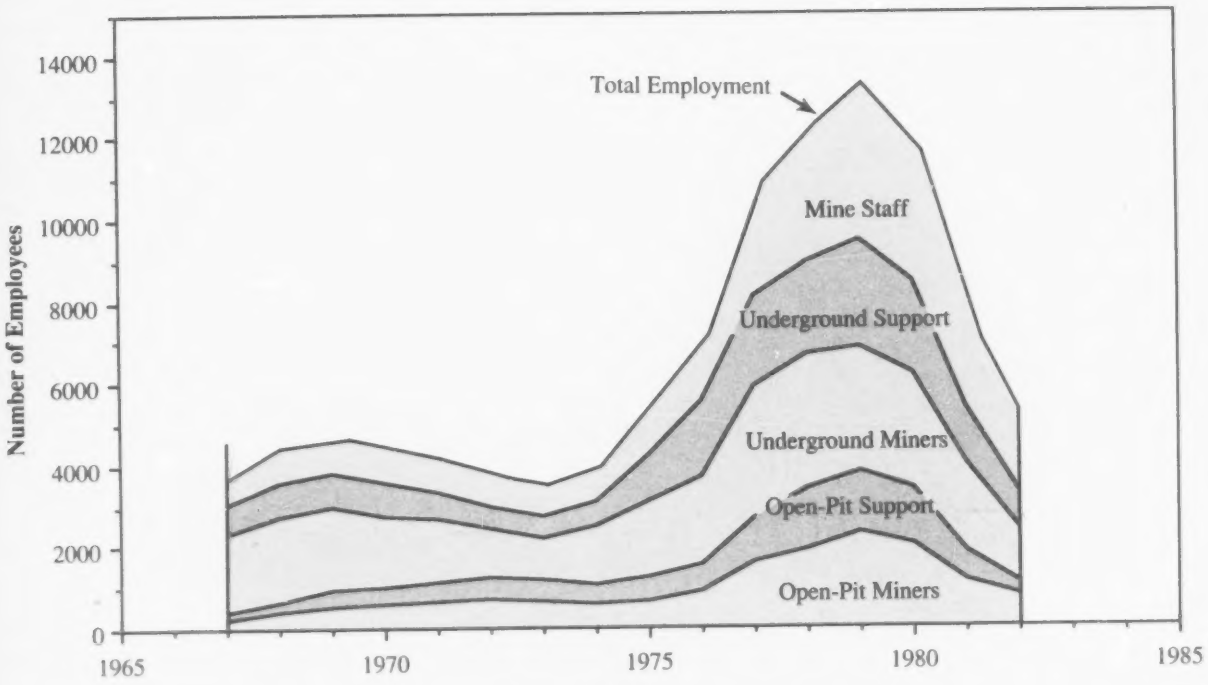

Figure 5
MINE EMPLOYMENT BY CLASSIFICATION

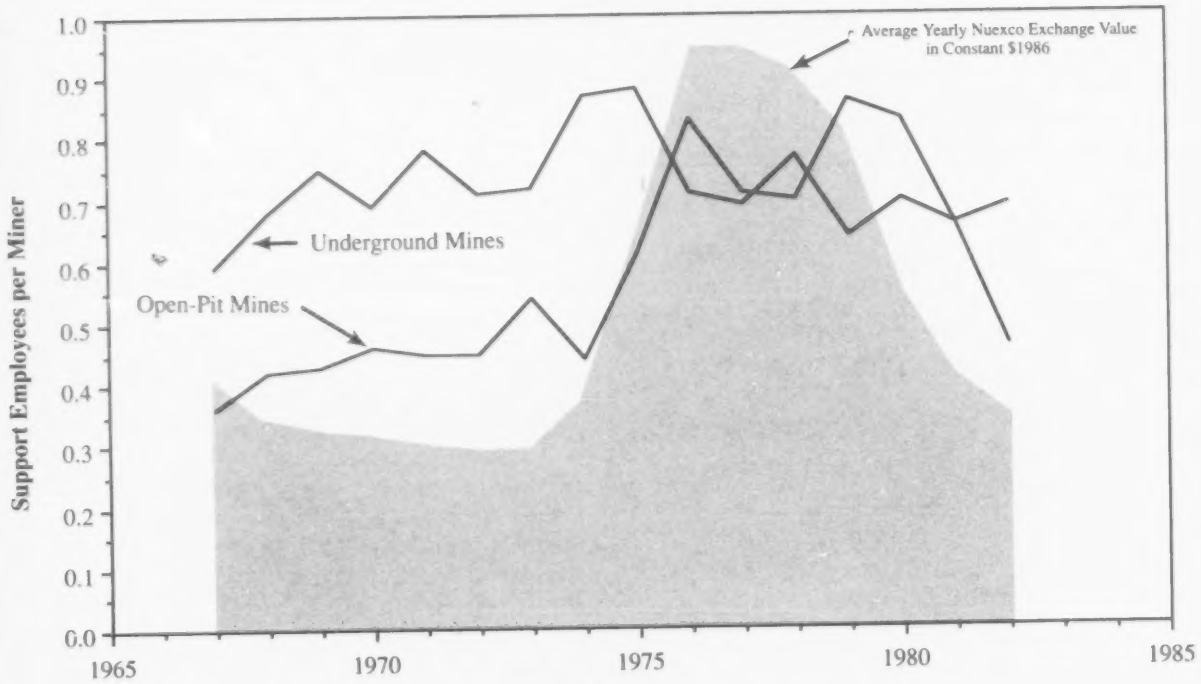

Figure 6
RATIO OF SUPPORT AND SERVICE PERSONNEL TO MINE OPERATING PERSONNEL

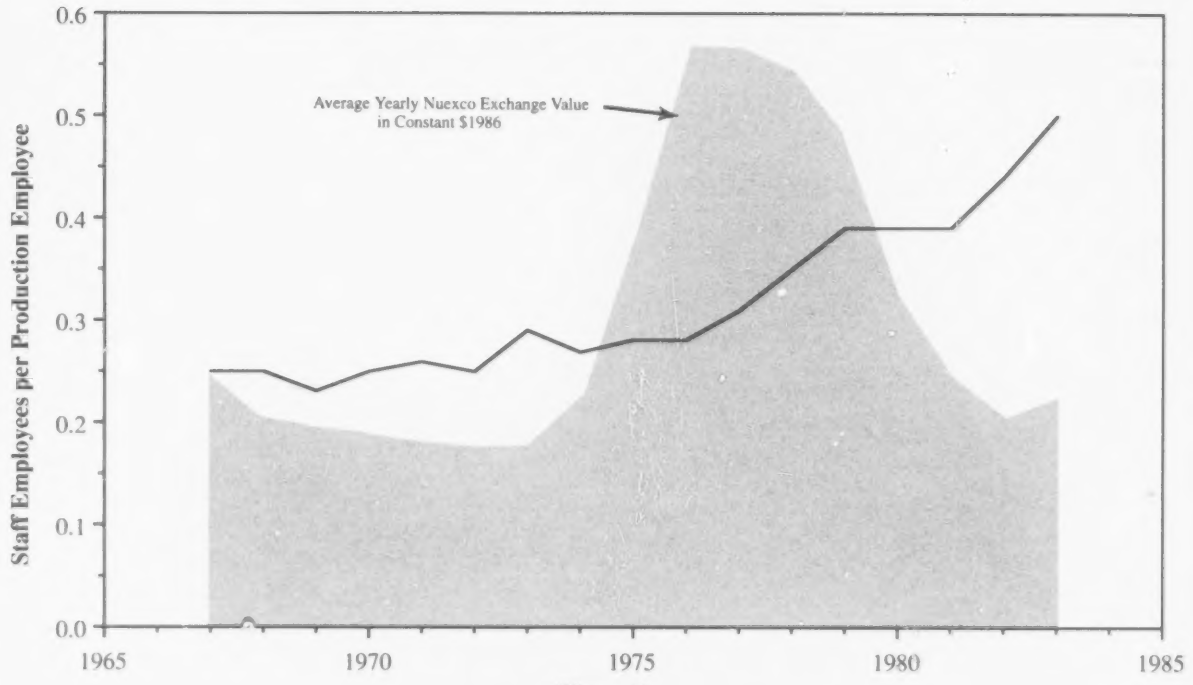

Figure 7
RATIO OF MINE STAFF EMPLOYEES
TO MINE PRODUCTION EMPLOYEES

mining listed the following US metal mining productivities based on US Department of Labor and Bureau of Mines data for 1982 (Table 1).

Table 1
UNDERGROUND MINING PRODUCTIVITY

Type of Ore	Productivity (Short Tons of Rock/Man-hour)
Copper	3.0
Gold	0.7
Iron	16.8
Lead and Zinc	1.7
Tungsten	1.3
Uranium	0.8

The principal reason for the differences shown is the degree of selectivity required in mining a "typical" deposit for each type of ore. Iron is commonly mined from massive deposits where large, efficient equipment can be utilized. Gold is commonly mined very selectively with small-scale equipment. Most uranium is produced on a scale and methodology similar to that used for lead and zinc, but two primary differences are apparent:

1. Underground uranium mines require substantial efforts for radon abatement through control of ventilation and drainage; and

2. Most underground uranium mines occur in relatively soft rocks which are not-self-supporting and which, when wet, degenerate to mud.

Figure 8 shows two views of productivity in US uranium mines. This figure provides support for the following observations.

Mining productivity should remain relatively constant for "type" deposits and technologies. Figure 8, however, shows a significant drop in ore per manshift productivity during the peak price period of 1975 to 1979. This drop could mean "slacking off" during a period of plenty, as opposed to "belt tightening" during bad times. For open-pit mining, the drop-off may better reflect increased stripping ratios, while for underground mining, it may reflect increased development.

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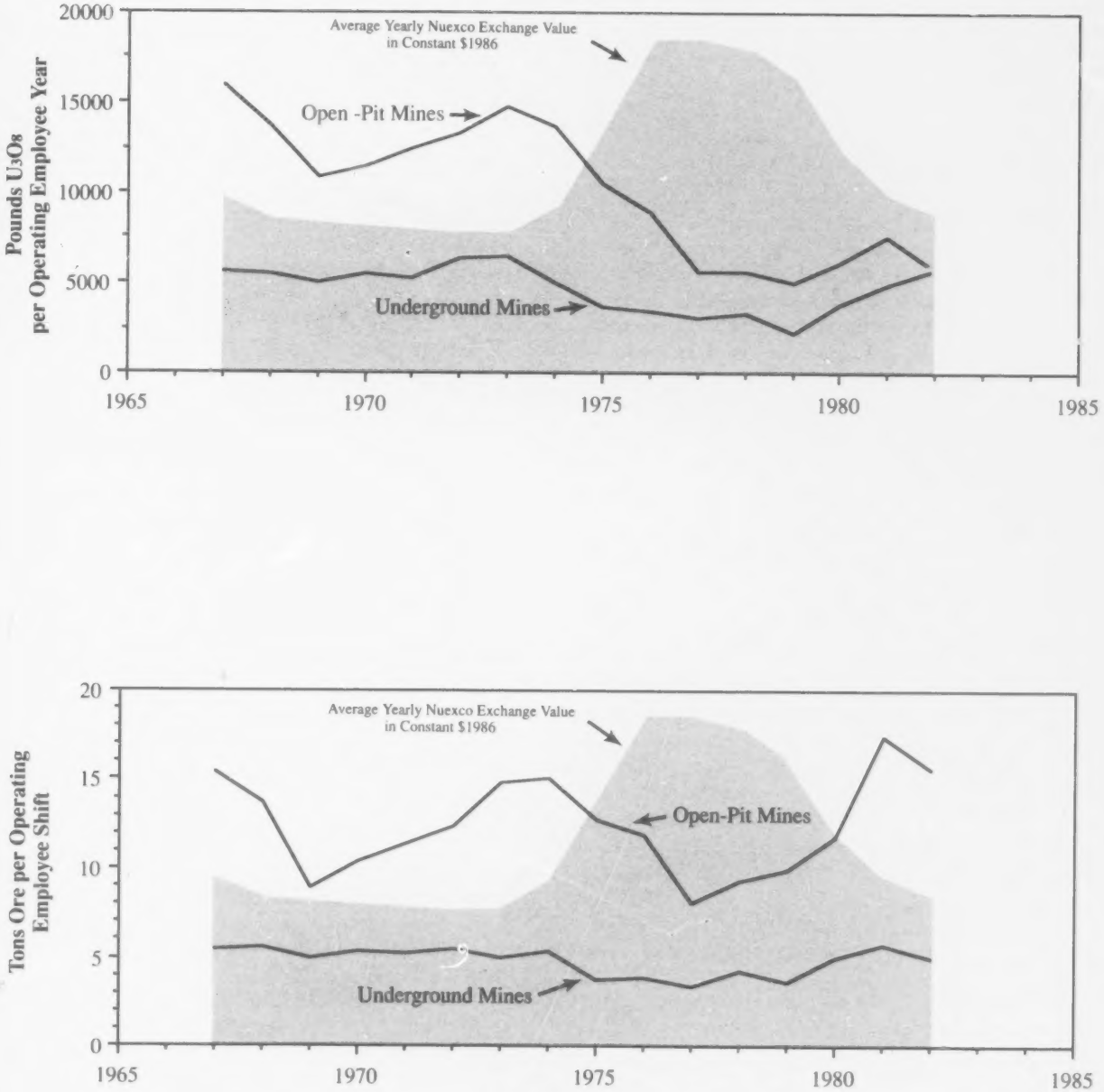

Figure 8
URANIUM MINE PRODUCTIVITY
BY MINE TYPE

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Comparing open-pit and underground productivities on a pounds U_3O_8 basis, during most of the period, open-pit miners generated far more pounds U_3O_8 per manshift than did underground miners. More recently, that gap has narrowed considerably. One might speculate that this difference is due to the increased mechanization at open-pit mines and is offset to some degree by higher capital-cost requirements. This measure of productivity mirrors price changes almost directly, and shows the cut-off grade mechanism at work.

Conclusions

Since most of the major changes in production, employment and productivity are coincident to major changes in price, there can be little doubt that the changes are directly related. Much of this relationship can be attributed to the cut-off grade mechanism which provides a certain flexibility to most mining operations. Mining costs are related to tons of ore and waste handled, and mining revenues (at a given metal price) are related to the metal content of the ores. The cut-off grade mechanism allows a balancing of the cost/revenue equation, which dampens the influence of price changes. This mechanism also allows for increasing utilization of lower-grade resources in times of higher prices, and assures an almost unlimited supply (albeit at higher costs) of those resources. Some of these relationships are summarized in Table 2, which compares various characteristics of underground mining for the years 1973 and 1979.

Thus, major changes in productivity and price nearly offset each other in terms of the value produced per labor dollar. In terms of increased reserves, however, one may speculate that a 50-percent decrease in economically exploitable ore grade might result in a four-fold increase in economically exploitable reserves.

Uranium mine employment appears directly related to price and should enjoy some resurgence as a result of the recent court decision in favor of the US uranium producers. Much of this resurgence is likely to be several years into the future, largely due to the lead times required for expansion of production, but an eventual increase in uranium mine employment numbered in the thousands is a reasonable expectation. If past trends continue, an expansion of uranium production will require an increasing number of mine staff employees, both for technical and administrative support. Changes in future uranium prices can therefore be expected to fuel continuing change in uranium production, employment and productivity.

Table 2
UNDERGROUND MINING
PRODUCTIVITY ANALYSIS

Item	1973	1979	Percent Change
Tonnage Productivity (Tons Ore per Manshift)	5.2	3.8	- 27
Average Ore Grade (% U_3O_8)	0.25	0.12	- 52
Uranium Productivity (Pounds U_3O_8 per Manshift)	26.0	9.1	- 65
Nuexco Exchange Value (1986 $/lb. U_3O_8)	15.89	56.18	+254
Dollar Productivity (1986 $ per Manshift)	413.14	511.24	+24
Labor Cost (1986 $ per Manshift)	95.99	97.87	+2
Value Produced per Labor Dollar (1986$)	4.30	5.22	+21

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THE URANIUM MARKET: IMPLICATIONS FOR SUPPLIERS

This article is an edited version of the speech given by Nuexco's R. Gene Clark, at the Uranium Institute's Twelfth Annual Symposium in London, England, September 4, 1987.

Introduction

It should be apparent that the buyers' market of the past several years has placed a great deal of strain on the world's uranium supply industry. Certainly some producers have enjoyed the benefits of older contracts, signed in the heyday of the sellers' market of the 1970s. However, not many of these typically fixed-quantity, escalated-price contracts will extend far into the future, and the world's uranium producers must recognize today's realities and tomorrow's uncertainties.

In the absence of effective restrictions on uranium imports into the USA, the marketplace will continue to be a buyers' market for at least a few years; but some of the factors causing this situation will ease as more nuclear power plants come into operation. To survive over the next several years, a producer will need not only favourable production costs but also an intelligent approach to the marketing of his product.

Today's Market

Several of the factors that turned the market from being a sellers' to a buyers' market were not a pleasant surprise to most nuclear fuel managers. The slowdown in nuclear construction, enormous cutback in planned nuclear programs, and the worse-than-expected operating performance of many nuclear plants have been important factors in the market's turnaround. To compound the problem both for nuclear fuel managers and uranium suppliers, one result of these under-realized expectations is still with us, in the form of large inventories of uranium on a worldwide basis. Only in the past two years have worldwide inventories started to decline toward more reasonable levels. Furthermore, in contrast to several years ago, inventory drawdown is almost exclusively by consumption rather than by sales on the open market. Although this is a welcome trend for the uranium and nuclear power industries, it will take at least five more years for these excess inventories to approach a normal level.

Producers can now rely on a solid base of operating nuclear stations, with more plants in advanced stages of construction. This means that the market demand for uranium will become increasingly based on real consumption rather than on expectations of future generating units' requirements. Uranium requirements should become much more predictable than in the past.

The majority of the world's economically inefficient production capacity has now been eliminated from serious consideration. Other than special situations in which certain producers still hold favourable long-term contracts, what remains of these high-cost projects, especially in the USA, is largely lingering production in lieu of reclamation. In the USA, there are some marginal mines and mills being held in partial standby status, partially in anticipation of an effective embargo on uranium imports. However, their owners seem to be primarily interested in financial assistance for mill decommissioning and mill-tailings cleanup.

Nuclear fuel managers have become increasingly more sophisticated in their approaches to managing and procuring uranium and nuclear fuel cycle services. Not too many years ago, industry consultants were much in demand by utilities to help plan utilities' fuel cycle activities, including the negotiation of contracts. While consultants are still providing these services, the level and scope of their involvement is much less than before. Utility fuel managers now generally use their own analytical tools to aid in their decision-making.

A fairly new development in the market is the increased importance of intermediaries — that is, entities that are neither producers nor consumers of uranium and fuel cycle services, but who may act as principals in the market. This development should not be confused with the much earlier phenomenon of reactor vendors or fabricators offering uranium, usually as part of a "package deal," to enhance their prospects in other areas. In past years, intermediaries were involved primarily in risk-free "back-to-back" deals, designed to mask identities and prices. However, their recent involvement has become more aggressive — taking commitments and attendant risks due to mismatches in delivery time, origin of material, delivery location, and form of uranium — in order to make the market function effectively.

In contrast to these changes in the marketplace, some things have not changed. Governments continue to regulate uranium trade, above and beyond their direct involvement as producers and consumers of uranium and nuclear fuel cycle services. Some governments still regulate export prices, transportation of exported material (because of nuclear nonproliferation concerns), and foreign investment in uranium production programs.

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The Market Outlook

Two central questions in the minds of current and potential uranium producers must be:

1. Who are the potential buyers?
2. What kind of market pricing can we expect?

We can answer the first question by considering some interesting but generally well-known market factors — shown in Figure 9. By geographical groups, the USA has the greatest unfilled requirements well into the future, followed by Europe and the Far East. (An unfilled requirement is the amount of uranium a company needs, over and above its inventory level and purchase contracts, to meet projected enrichment feed deliveries plus maintain a desired level of inventory.) Although Europe and the Far East have similar levels of unfilled requirements, the Far East has a higher fraction of its total requirements uncovered by commitments. These groupings have important implications for the future marketplace. Buyers in the USA generally feel that one year's level of forward coverage in inventory is desired and have tended to procure uranium with the shortest lead-time before needs. Utilities in the Far East generally have been the most concerned with security of supply and tend to have the highest level of desired forward coverage in inventory.

Perhaps even more important, potentially restrictive trade conditions have made the USA the focus of the greatest uncertainty. Thus, the country with the largest fraction of future unfilled requirements is also the most uncertain as far as trade considerations are concerned.

Future market prices are, of course, subject to much greater uncertainty than are unfilled requirements. Figure 10 represents Nuexco's estimate of the distribution of world uranium production costs through the year 2000. These costs are for the lowest forward-cost properties required to balance supply and demand for the period. It is highly unlikely that the bulk of this required production will come into the market at current prices.

Many factors could affect the outlook for future prices. Perhaps the most important factor in the intermediate term is the prospect of a prolonged restriction on the use or enrichment of imported uranium in the USA, especially in view of its large fraction of the world's unfilled requirements. Another potentially influential factor will be the political situation both within South Africa and between South Africa and other countries. In the long term, there is

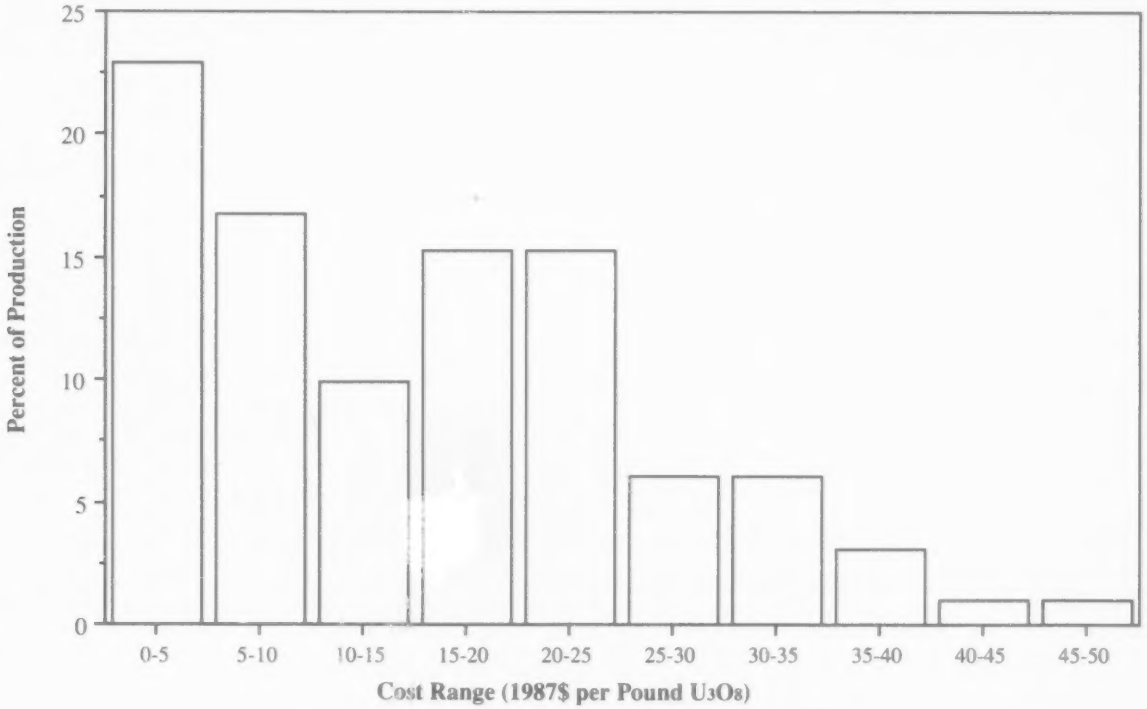

Figure 9
PROJECTED DISTRIBUTION OF FORWARD COSTS

the potential both for easing of export regulations and for the development of new deposits in Australia and Canada, factors especially important because of the large volume of undeveloped uranium resources in those countries.

Future Market Considerations Affecting Producers

The central problem facing the world's producers is that of surviving until better times. Although some producers have favourable long-term contracts to help them through the expected transition period, their production costs must be competitive over the long term to assure their survival. Having a low relative production cost is the best assurance of viability in the long term.

From a utility's perspective, the basic objective of a uranium procurement programme is to obtain a sufficient supply of uranium at a reasonable cost and with adequate assurance and flexibility of supply. A balance often must be drawn between cost and security of supply. Also, a well-designed procurement programme will allow for flexible response to changing market conditions. In the coming marketplace, producers will have offer to buyers three very important features in order to be successful. These features are flexibility in quantity, delivery schedule, and price.

The degree of flexibility offered by suppliers of enrichment services has a clear effect. Led by the US Department of Energy (DOE), nearly all of the primary enrichers are offering "requirements" contracts, generally having variable tails assay options. That is, enrichment contracts specify that the customers may adjust their purchases of enrichment services to match their reactors' requirements, or a stated fraction thereof. Given this flexibility, utilities also want flexibility in their natural uranium and UF_6 conversion contracts. One sign of this buyer objective is that new uranium contracts today typically offer a 20-percent flexibility in quantities to be supplied under such contracts. Prices frequently are partially or entirely related to market indices, and deliveries are allowed to stretch out over several months.

Risk aversion also is an important force influencing utilities' desire for flexibility — in quantities, delivery schedules, and prices. Utilities with large nuclear power programs frequently and wisely rely on several suppliers and several price mechanisms. For example, a utility might have several uranium supply contracts in place for each year's requirements, each with a 20-percent optional quantity above and below a stated amount. This type of arrangement would give the utility a great deal of maneuvering room to respond to the most economical enrichment tails assay, achieve the lowest overall price (including the option of purchasing in the spot market), and limit the impact of nonperformance by one of the suppliers.

Another type of flexibility desired by utilities is the right to terminate contracted deliveries in the event of unforeseen delays or prolonged shutdowns of the covered reactor or, in the USA, in the event that the material to be supplied becomes restricted from use in their reactors, because of origin or other factors. The latter factor is, or course, very important to non-US producers attempting to sell to US companies.

Finally, utilities in this buyers' market are highly sensitive to pricing terms. Many sellers for intermediate-term delivery have been successful by offering "market-related" prices (usually discounts from the spot price) with no price floors. In the USA, such pricing terms are encouraged by the nature of electricity price regulation, in which utilities paying uranium prices higher than the spot market price may not be allowed to pass on all such costs to the consumers, while utilities paying less than the spot price are not rewarded for their foresight. In Europe, utilities are relying to a greater extent than ever before on spot market purchases, although the quantities of such purchases still are much smaller than deliveries under older long-term contracts.

Conclusion

The current buyers' market is expected to continue at least for a few years, an outlook that is not welcome news for the world's uranium producing industry. This expectation, together with the state of maturity of utility nuclear fuel management and procurement practices, will continue to encourage competition in the uranium industry. Assuming free market conditions in the future, we expect that production costs required to balance supply and demand will have to be above current spot market prices but well below those of the late 1970s (in constant US dollars). During this period (as in any other buyers' market), producers will have to keep production costs very low in order to be able to compete and will have to be very imaginative in their offering of price, delivery-schedules and quantity flexibility terms.

Of course, the development of an effective restricted market in the USA could cause a major change in this outlook, to the benefit of US producers and the detriment of non-US producers. The degree of this benefit to US producers will be determined by the level of restrictions, US inventory levels, and (most of all) the extent to which DOE will accept grandfathered, swapped, or exchanged material for enrichment and subsequent use in US-utilities' reactors.

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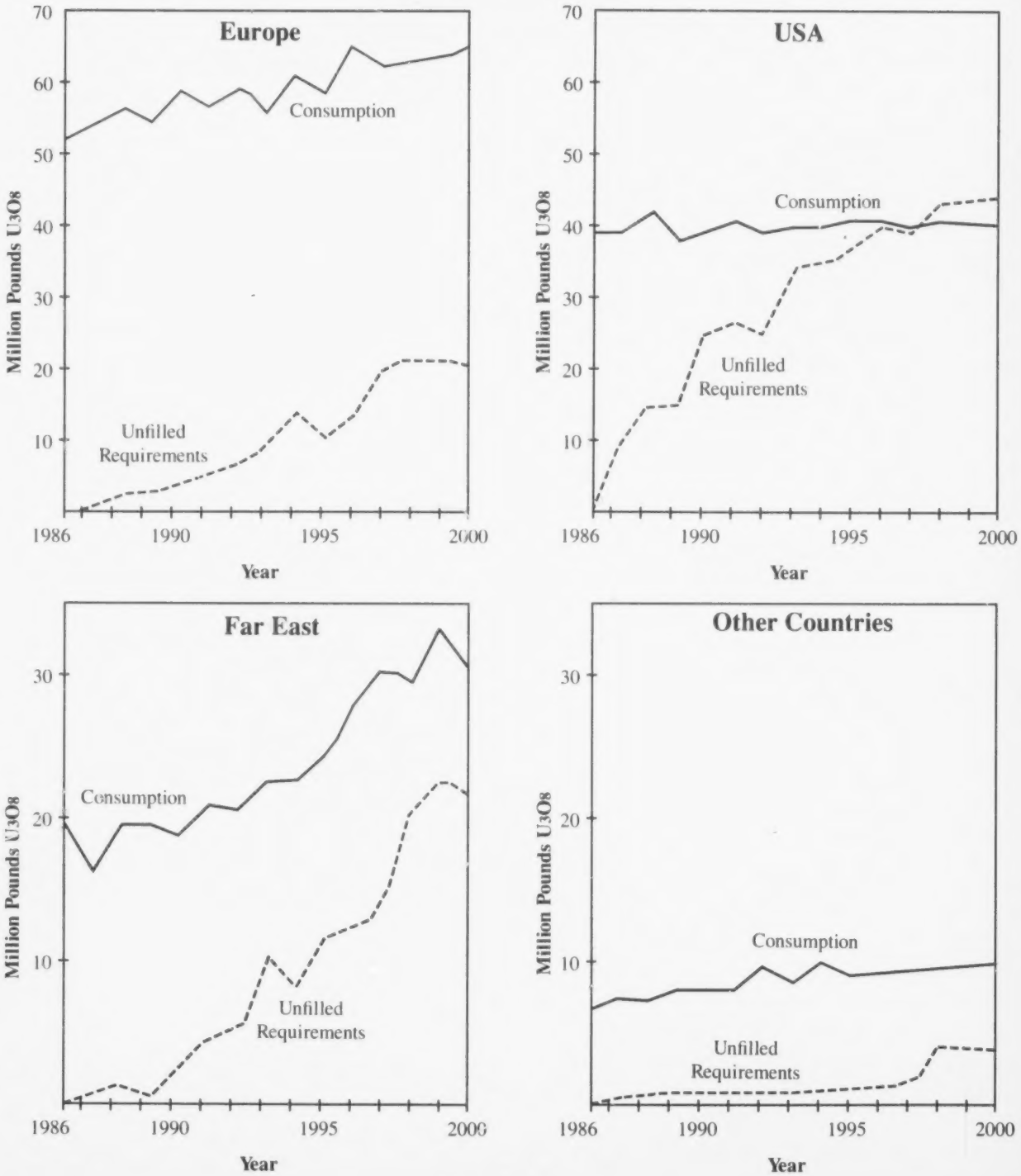
Figure 10
TOTAL CONSUMPTION AND
UNFILLED REQUIREMENTS, BY REGION



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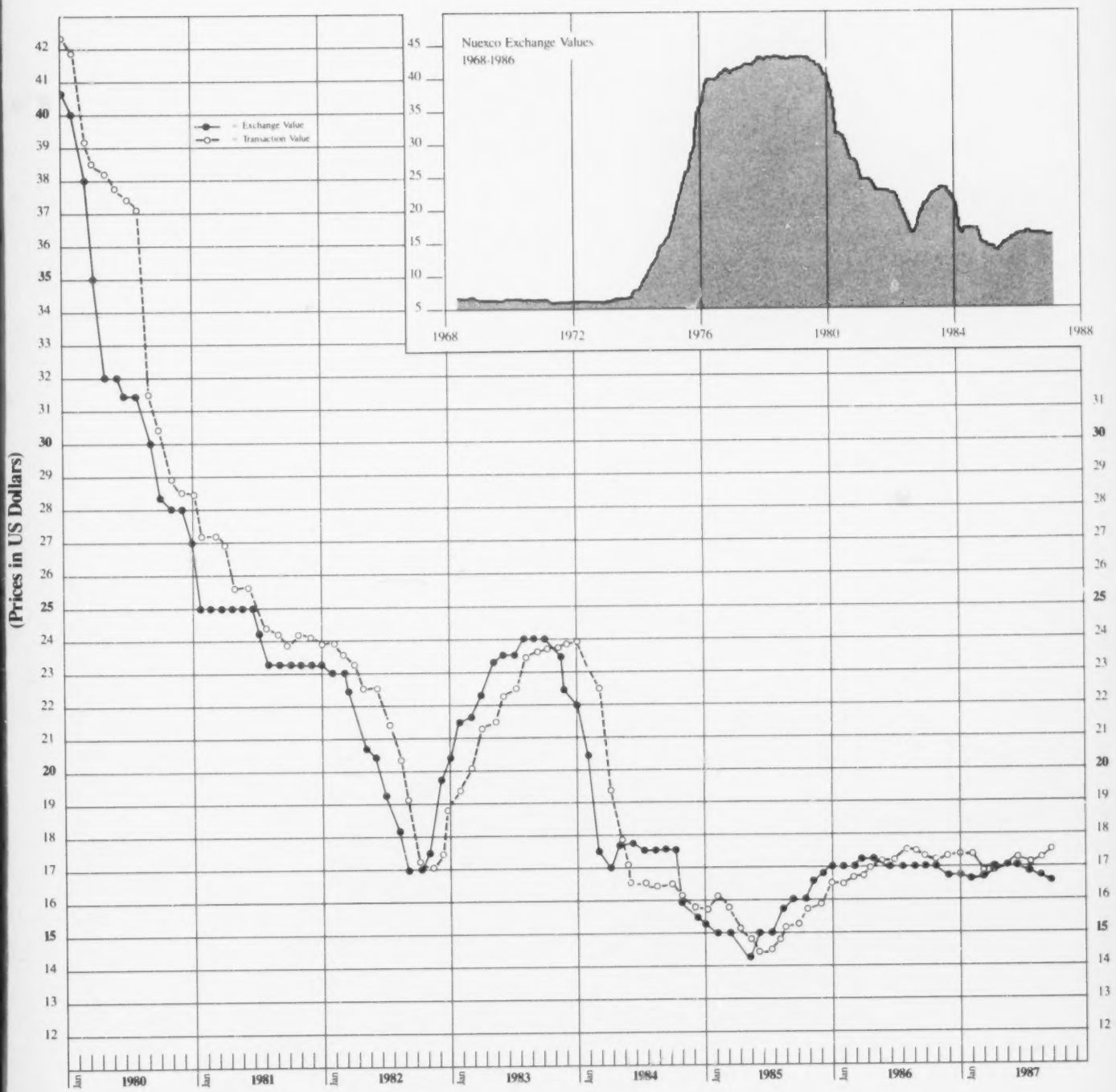
HISTORICAL MARKET DATA



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HISTORICAL MARKET DATA

HISTORICAL EXCHANGE VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1968	—	—	—	—	—	—	—	6.35	6.35	6.40	6.45	6.50
1969		6.35	6.10	6.10	6.25	6.25	6.20	6.20	6.15	6.15	6.15	6.20
1970	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.20	6.15	6.15	6.15	6.15
1971	6.20	6.20	6.20	6.20	6.15	6.05	6.00	5.95	5.95	5.95	5.95	5.95
1972	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95
1973	5.95	6.00	6.10	6.20	6.45	6.50	6.50	6.50	6.50	6.50	6.75	7.00
1974	7.70	7.90	8.00	9.00	9.50	10.50	11.50	12.00	12.50	14.00	14.75	15.00
1975	16.00	16.00	18.00	20.00	21.00	23.00	24.70	26.00	26.00	28.50	30.00	35.00
1976	35.20	37.00	39.25	40.00	40.00	40.00	40.00	40.40	41.00	41.00	41.50	41.00
1977	41.35	41.50	41.60	41.60	42.00	42.25	42.25	42.25	42.40	42.75	43.20	43.20
1978	42.90	43.25	43.25	43.25	43.40	43.40	43.40	43.10	43.25	43.00	43.25	43.25
1979	43.25	43.25	43.25	43.25	43.25	43.00	42.70	42.70	42.20	42.20	41.00	40.75
1980	40.00	38.00	35.00	32.00	32.00	31.50	31.50	30.00	28.50	28.00	28.00	27.00
1981	25.00	25.00	25.00	25.00	25.00	24.25	23.50	23.50	23.50	23.50	23.50	23.50
1982	23.00	23.00	22.50	20.75	20.50	19.25	18.25	17.00	17.00	17.50	19.75	20.25
1983	21.50	21.75	22.25	23.25	23.50	23.50	24.00	24.00	24.00	23.50	22.50	22.00
1984	20.50	17.50	17.00	17.75	17.75	17.50	17.50	17.50	17.50	16.00	15.50	15.25
1985	15.00	15.00	15.00	14.25	15.00	15.00	15.75	16.00	16.00	16.50	16.75	17.00
1986	17.00	17.00	17.25	17.25	17.00	17.00	17.00	17.00	17.00	17.00	16.75	16.75
1987	16.65	16.75	17.00	17.00	17.00	16.90	16.75	**16.65**				

HISTORICAL TRANSACTION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976	—	—	—	—	39.60	39.70	39.70	40.40	40.30	40.60	40.70	40.70
1977	41.30	41.30	41.40	41.50	42.80	42.90	43.00	42.60	42.50	42.80	42.90	42.90
1978	43.10	43.30	43.70	43.60	43.60	43.20	43.30	43.40	43.40	43.60	43.40	43.70
1979	43.60	43.80	43.70	43.40	43.60	43.70	43.70	43.60	43.60	43.60	43.50	42.30
1980	42.00	39.30	38.60	38.40	37.90	37.60	37 30	31.30	30.60	29.00	28.70	27.70
1981	27.20	27.20	27.00	25.70	25.70	24.50	24.40	24.30	23.90	24.10	24.10	24.00
1982	24.00	23.70	23.40	22.60	22.70	21.50	20.30	19.10	17.30	17.00	17.55	18.80
1983	19.35	20.00	21.35	21.40	22.35	22.45	23.50	23.60	23.65	23.65	23.85	23.85
1984	23.05	22.50	19.25	17.90	17.00	16.50	16.60	16.40	16.55	16.05	15.90	15.90
1985	16.20	15.70	15.05	14.90	14.45	14.60	14.75	15.10	15.10	15.75	15.80	16.55
1986	16.55	16.70	16.70	17.10	17.05	17.20	17.50	17.45	17.35	17.25	17.30	17.35
1987	17.35	16.90	16.95	17.00	17.20	17.10	17.30	**17.55**				

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HISTORICAL CONVERSION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U in UF_6)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1981	1.20	1.20	1.20	1.40	1.15	1.15	1.15	1.10	1.10	1.10	1.20	1.20
1982	1.20	1.20	1.20	1.20	1.00	1.00	1.00	0.90	1.10	1.60	1.45	1.45
1983	1.20	1.40	1.40	1.20	1.20	1.20	1.10	1.10	1.00	0.60	0.60	0.60
1984	0.60	0.30	0.80	0.80	0.80	0.00	0.00	0.80	1.00	1.00	0.80	0.80
1985	1.00	1.00	1.00	1.50	1.50	1.60	1.60	1.60	1.60	1.60	1.60	1.60
1986	1.60	1.80	1.90	1.80	1.80	1.80	1.80	1.90	1.90	1.90	1.80	1.80
1987	1.80	1.80	1.80	1.80	1.80	1.80	1.90	**1.90**				

HISTORICAL UF_6 VALUES

Determined as of the last day of the month indicated (US Dollars/kg. U in UF_6)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1985	—	—	—	40.50	42.50	42.50	44.00	44.50	44.50	46.00	46.00	47.00
1986	47.00	48.00	48.00	48.50	48.25	48.25	48.25	48.00	48.00	48.00	48.00	47.75
1987	47.75	48.00	48.00	48.00	47.75	47.75	47.50	**47.00**				

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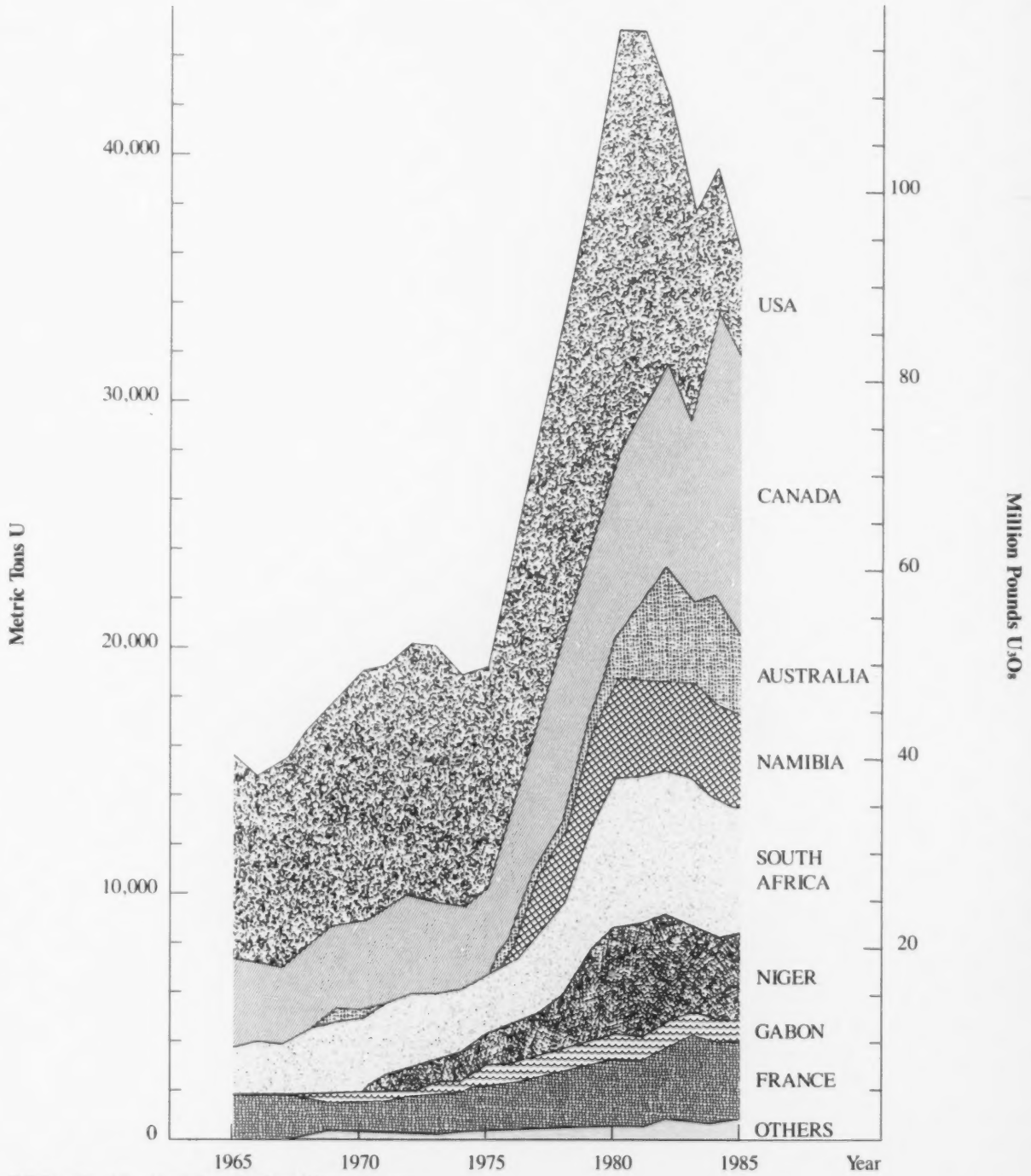
HISTORICAL MARKET DATA

HISTORICAL WOCA[1] URANIUM PRODUCTION[2]
(Compiled by OECD/IAEA Joint Report[3])



[1]WOCA = World Outside of Centrally-planned Economic Areas.

[2]1985 production data are preliminary.

[3]A joint report issued biennially by the OECD Nuclear Energy Agency and the International Atomic Energy Agency.

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US URANIUM MARKETING ACTIVITIES STATISTICS[1]
(Compiled from data published by the US Energy Information Administration)

Year	Total Production[2] (million pounds U_3O_8)	Deliveries to Domestic Utilities[3] (million pounds U_3O_8)	Average Price of Delivered Uranium ($/lb. U_3O_8)	Quantity of Uranium Imported[4] (million pounds U_3O_8)	Average Price of Imported Uranium ($/lb. U_3O_8)	Quantity of Uranium Exported (million pounds U_3O_8)
1976	25.5	n/a	n/a	3.6	n/a	1.2
1977	29.9	n/a	n/a	5.6	n/a	4.0
1978	37.0	n/a	n/a	5.2	n/a	6.8
1979	37.5	33.0[5]	$23.85[5]	3.0	n/a	6.2
1980	43.7	35.0[5]	$28.15[5]	3.6	$43.10	5.8
1981	38.5	32.6[5]	$34.65[5]	6.6	$32.90	4.4
1982	26.9	27.1	$38.37	17.1	$27.23[6]	6.2
1983	21.2	24.2	$38.21	8.2	$26.16	3.3
1984	14.9	22.5	$32.65	12.5	$21.86	2.2
1985	11.3	21.7	$31.43	11.7	$20.08	5.3

[1]Sources: 1979: US Department of Energy, Assistant Secretary for Resource Applications, Office of Uranium Resources and Enrichment, *Survey of United States Uranium Marketing Activity*, DOE/RA-0053 (Washington DC, July 1980). 1980-1981: US Department of Energy, Assistant Secretary for Nuclear Energy, Office of Uranium Enrichment and Assessment, *Survey of United States Uranium Marketing Activity*, DOE/NE-0013 and DOE/NE-0013/1 (Washington DC, June 1981 and July 1982). 1982: Energy Information Administration, *1982 Survey of United States Uranium Marketing Activity*, DOE/EIA-0403 (Washington DC, September 1983). 1983: Energy Information Administration, *Survey of United States Uranium Marketing Activity 1983*, DOE/EIA-0403(83) (Washington DC, August 1984). 1984: Energy Information Administration, Form EIA-858, "Uranium Industry Annual Survey" (1984). 1985: Energy Information Administration, Form EIA-858, "Uranium Industry Annual Survey" (1985).

[2]Sources: 1976-1982: US Department of Energy, Grand Junction Area Office, *Statistical Data of the Uranium Industry*, GJO-100 (Grand Junction, Colorado, January 1983). 1983: Calculated by the staff of the Nuclear and Alternate Fuels Division, Office of Coal, Nuclear, Electric and Alternate Fuels, Energy Information Administration, from US Department of Energy, Grand Junction Area Office data files. 1984: Energy Information Administration, Form EIA-858, "Uranium Industry Annual Survey" (1984). 1985: Energy Information Administration, Form EIA-858, "Uranium Industry Annual Survey" (1985).

[3]Excludes direct imports by domestic utilities.

[4]Includes imports by domestic utilities and domestic suppliers.

[5]Includes delivery commitments to domestic utilities and agents.

[6]Computation of quantity-weighted average price excludes the quantity associated with a large exchange (swap) transaction that occurred in 1982.

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HISTORICAL MARKET DATA

VOLUME AND PRICE OF URANIUM DELIVERIES TO THE EUROPEAN COMMUNITY[1]
(Compiled from data published by the Euratom Supply Agency)

Year	Volume of Deliveries to the EC[2] (in MTU)	Percentage of Deliveries Made Under Spot Contracts	Medium or Long-Term Contracts[3,4]		Spot Contracts[3,4]	
			Average Price in ECU per pound U_3O_8	Average Price in US Dollars per pound U_3O_8	Average Price in ECU per pound U_3O_8	Average Price in US Dollars per pound U_3O_8
1977	n/a	n/a	n/a	n/a	n/a	$41.00
1978	n/a	n/a	n/a	n/a	n/a	$43.00
1979	10,000	n/a	n/a	n/a	n/a	$44.50
1980	8,600	n/a	n/a	$36.00	n/a	$35.00
1981	13,000	less than 10	n/a	$33.25	n/a	$28.00
1982	12,500	less than 10	ECU 32.25	$32.00	ECU 24.25	$24.00
1983	13,500	less than 10	ECU 34.75	$31.00	ECU 26.00	$23.25
1984	11,000	less than 10	ECU 37.75	$29.75	ECU 24.50	$19.25
1985	11,000	11.5	ECU 38.00	$29.00	ECU 19.50	$15.00

[1]The twelve European Community member nations are Belgium, Denmark, France, the Federal Republic of Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, and the United Kingdom; prior to January 1986, Spain and Portugal were not members of the EC.

[2]The only deliveries taken into account are those made to final users, namely the electric utilities or their procurement organizations; deliveries to middlemen or fuel cycle companies are not included. The sales between utilities in the Community are also excluded. The quantities covered are those which were entered into accounting records during the year stated.

[3]For deliveries made under medium or long-term contracts (i.e., for which the time between the date of signature and the date of the last delivery exceeds one year) the prices were expressed in seven different currencies. In order to calculate an average price, these prices have been converted into European Currency Units (ECU) and US dollars. The average prices were weighted by quantity and converted on the basis of the average annual exchange rate of the different currencies against the ECU and US dollar.

[4]Exchange rates as published by European Communities Statistical Office and the International Monetary Fund.

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GOVERNMENT STATISTICS

AUSTRALIA

	Consumer Price Index[1]	Price Index of Materials Used in Manufacturing Industry — All Groups[2]	Award Rates of Pay Indexes Australia — Adult Males In Mining Wage Earners, Weekly Rates[3] (1976 = 100)
1975 Avg.	57.9	150.4	132.6
1976 Avg.	65.7	168.4	160.9
1977 Avg.	73.8	192.0	179.0
1978 Avg.[4,5]	79.7	198.5	190.0
1979 Avg.	86.9	248.8	127.9
1980 Avg.	95.8	321.8	140.8
1981 Avg.	105.0	355.3	154.1
1982 Avg.[6]	116.7	368.6	174.9
1983 Avg.	128.5	401.6	181.8
1984 Avg.	133.6	95.3	194.1
1985 Ave.	142.6	100.0[4]	203.2
1986 Avg.	155.5	104.9[4]R	213.7
Jan 1986	—	109.5R	211.2
Feb 1986	—	108.7	211.2
Mar 1986	150.5	99.4R	211.2
Apr 1986	—	94.2R	211.2
May 1986	—	93.5	211.2
Jun 1986	153.0	95.6R	211.2
Jul 1986	—	97.9R	216.0
Aug 1986	—	98.1R	216.0
Sep 1986	157.0	105.5R	216.0
Oct 1986	—	106.0R	216.1
Nov 1986	—	105.0R	216.3
Dec 1986	161.5	105.4R	216.2
Jan 1987	—	106.3R	216.2
Feb 1987	—	109.1R	216.5
Mar 1987	164.7	108.5P	217.0
Apr 1987	—	108.4P	—

P = Preliminary R = Revised since last month

[1]Weighted average of six State capital cities (1975 to 1980), and eight capital cities from 1981 (Base: year 1980-81 = 100.0).

[2]Australian Bureau of Statistics, Canberra: "Price Index of Materials Used in Manufacturing Industry" (Catalogue No. 6411.0). The basis of this index is 1968/1069 = 100 for years 1975-1983, and 1984/1985 = 100 for all subsequent data.

[3]Australian Bureau of Statistics, Canberra: "Award Rates of Pay Indexes, Australia" (Catalogue No. 6312.0). Basis is 1975 = 100 for years 1975-1978, and 1976 = 100 for all subsequent data.

[4]Annual averages are for financial year ending June 30.

[5]Monthly data for 1970-78 appear on pages 4.7 and 4.8 of Report 138.

[6]Monthly data for 1979-82 appear on page 35 of Report 184.

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GOVERNMENT STATISTICS

CANADA

			Wage-earner Data: Average Hourly Earnings (C$)[2]					
		Industry Products Price Index: All Commodities[1] (1981 = 100)	Uranium Mines (SIC 057)	Metal Mines (SIC 051-059)	Mines, Quarries and Oil Wells[3] (SIC 051-099)	Primary Non-ferrous Metal Industries[4] (SIC 296)	(SIC 298)	Chemicals and Chemical Products[5] (SIC 372-379)
1979	Avg.[6]	217.9	—	9.60	9.66	—	—	7.67
1980	Avg.	247.2	—	10.58	10.80	—	—	8.50
1981	Avg.	288.7	—	12.02	12.23	—	—	9.53
1982	Avg.[7]	288.8	—	13.74	13.92	—	—	10.63
1983	Avg.	298.8	—	—	14.30	—	—	11.17
1984	Avg.	310.9	17.88	—	—	—	—	—
Jan	1985	117.5	18.05	16.13	15.60	12.32	10.80	12.04
Feb	1985	117.7	18.78	16.41	15.68	12.52	11.05	12.06
Mar	1985	118.4	18.24	16.21	15.57	12.44	10.97	12.02
Apr	1985	118.3	18.63	16.44	15.80	12.81	11.23	12.04
May	1985	118.6	19.41	16.51	15.63	12.76	11.25	12.15
Jun	1985	118.6	18.49	16.20	15.49	12.89	11.14	12.14
Jul	1985	118.6	18.14	16.27	15.41	12.96	11.17	12.13
Aug	1985	118.4	17.07	16.03	15.30	12.97	11.31	12.19
Sept	1985	118.6	18.53	16.55	15.72	12.95	11.39	12.26
Oct	1985	119.0	18.74	16.51	15.70	13.14	11.53	12.33
Nov	1985	119.3	19.05	16.66	15.88	12.76	11.32	12.49
Dec	1985	120.0	19.07	16.57	16.01	12.51	11.09	12.59
Jan	1986	121.0	18.15	16.22	15.86	13.11	11.48	12.52
Feb	1986	120.8	19.52	16.57	15.99	13.20	11.59	12.45
Mar	1986	120.1	19.04	16.65	15.93	13.11	11.59	12.54
Apr	1986	119.3	19.38	16.68	15.95	13.07	11.64	12.54
May	1986	118.4	19.54	16.68	15.78	13.16	11.72	12.51
Jun	1986	118.6	19.80	16.63	15.64	13.44	11.86	12.49
Jul	1986	118.8	19.51	16.34	15.48	13.28	11.73	12.52
Aug	1986	119.1	18.39	16.17	15.46	13.31	11.31	12.70
Sep	1986	119.4	19.32	16.62	15.78	13.14	11.45	12.90
Oct	1986	119.9	19.97	16.81	16.11	13.30	11.59	12.94
Nov	1986	119.9	20.11	17.01	16.24	13.42	11.66	12.93
Dec	1986	119.7	19.67	16.79	16.19	13.06	11.57	12.99
Jan	1987	120.0	19.53	16.93	16.01	13.06	12.58	12.89
Feb	1987	119.8	20.33	17.20	16.21	13.01	12.66	13.11
Mar	1986	120.3	20.04	17.14	16.15	13.57	12.58	13.02
Apr	1987	121.1	20.47	17.38	16.26	13.75	11.99	13.27
May	1987	122.0R	20.50	17.12R	15.96R	14.23R	11.44R	13.19R
June	1987	122.3P	20.41P	17.09P	15.76P	13.94P	12.82P	12.90P

P = Preliminary R = Revised since last month

[1]Statistics Canada, Prices Division, Ottawa: "Industry Price Indexes" (Catalogue 62-011). Indexes for the most recent six months shown are subject to revision. This category was formerly known as "Manufacturing." Index prior to 1985, 1971 = 100.

[2]Statistics Canada, Labour Division, Employment and Payrolls Section, Ottawa: "Employment, Earnings and Hours" (3Reports 175 through 185 list this series title incorrectly as "Metal Mining, Including Milling (SIC 050-099)"Æ Beginning with the March 1983 figure, Wage Earner Data are based on a census of all companies employing 200 or more wage earners, plus a random survey of companies employing fewer than 200 wage earners. Prior to March 1983 only companies employing 200 or more wage earners are included in the Wage Earner Data. Wage Earner Data were further revised in January 1987 and now reflect a slightly different base than previously.

[3]Reports 175 through 185 list this series title incorrectly as "Metal Mining, Including Milling (SIC 050-099)."

[4]Beginning with the April 1983 figure, Primary Metal Industries, non-ferrous is split into SIC 296 and SIC 298.

[5]Chemical and Chemical Products prior to April 1983 was SIC 370-379. The new series is from a new survey which includes all companies and is based on a 1970 classification. The old survey only included companies of 20 employees or more.

[6]Monthly ISPI data for 1977 and 1978 appear on page 4.10 of Report 138, and monthly wage-earner data for 1973-78 appear on page 4.11 of Report 138.

[7]Monthly data for 1979-1982 appear on page 37 of Report 184. On that page, the wage earner index entitled "Metal Mining, Including Milling (SIC 050-099)" should read "Total Mining (SIC 051-099)".

REPUBLIC OF SOUTH AFRICA

		Average Declared Working Costs per Metric Ton of Gold Ore Milled (Rand)[1]	Tonnage-Weighted Index of Average Working Costs per Metric Ton of Gold Ore Milled (March 1982 = 100)[2]	Consumer Price Index[3] (1980 = 100)[4]	Producer Price Index All Groups[5] (1980 = 100)	Total Employment in Mining and Quarrying (Code 35)[6]	Total Salaries and Wages in Mining and Quarrying (1,000 Rand) (Code 40)[6]
1975	Avg.	16.71	—	157.2	100.0	639,473	1,003,617
1976	Avg.	19.30	—	174.7	115.1	671,240	1,212,983
1977	Avg.	23.87	—	194.4	130.0	712,006	1,420,670
1978	Avg.[7]	27.14	—	137.2	142.7	664,571	1,537,169
1979	Avg.	30.18	—	155.3	164.5	692,209	1,830,632
1980	Avg.[8]	35.53	—	176.7	192.1	714,379	2,279,615
1981	Avg.	41.89	—	206.5	218.3	728,506	2,820,505
1982	Avg.[9]	47.25	104.2	233.5	248.7	707,552	3,246,071
1983	Avg.	51.88	115.0	262.2	274.8	696,579	3,644,772
1984	Avg.	58.95	130.3	292.8	297.9	712,080	4,196,764
1985	Avg.	68.76	151.68	192.6	181.2	726,804	396,956
Jan	1986	—	—	213.8	203.6	744,070	449,513
Feb	1986	—	—	215.8	206.9	754,458	438,562
Mar	1986	75.76	167.8	218.3	206.9	759,897	445,387
Apr	1986	—	—	222.2	208.9	756,388	437,563
May	1986	—	—	222.6	212.5	754,788	425,544
Jun	1986	77.65	172.0	224.4	213.3	756,637	462,365
Jul	1986	—	—	228.8	216.3	756,140	516,832
Aug	1986	—	—	232.2	220.3	760,929	502,968
Sep	1986	81.94	181.8	236.7	221.9	765,772	511,363
Oct	1986	—	—	239.3	226.8	763,953	512,897
Nov	1986	—	—	242.4	230.2	761,325	531,509
Dec	1986	85.38	189.9	244.9	232.1	752,264	536,970
Jan	1987	—	—	248.3	233.9	740,031	532,577
Feb	1987	—	—	251.0	237.0	757,872R	598,986R
Mar	1987	88.17	197.1	255.0	239.6	762,697	536,006
Apr	1987	—	—	258.2	242.5	759,714	531,771
May	1987	—	—	261.2	243.6	—	—
Jun	1987	90.74	203.5	263.1	244.9	—	—
July	1987	—	—	266.2			

P = Preliminary R = Revised since last month

[1]Chamber of Mines of South Africa, Johannesburg: "Analysis of Working Results," published quarterly.
[2]Page 16 of Report 178 contains description and calculation of index, and page 24 of Report 178 lists figures for 1982.
[3]Republic of South Africa Department of Statistics, Pretoria: "Government Gazette: Consumer Price Index for Urban Areas."
[4]The basis for calculation prior to January 1985, 1975 = 100. For annual averages prior to 1978, April 1970 = 100.
[5]Previously known as the Wholesale Price Index, now the Producer Price Index. The computation remains the same. The basis for calculation prior to January 1985, 1975 = 100.
[6]Bulletin of Statistics, Department of Statistics, Pretoria.
[7]Historical data for the Average Declared Working Costs and Consumer Price Index 1970-1979 appear on page 4.9 of Report 140.
[8]Monthly data for Codes 35 and 40, 1977-1980, appear on page 28 of Report 157
[9]Monthly data for 1979-82 appear on page 39 of Report 184.

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GOVERNMENT STATISTICS

UNITED STATES

		Producer Price Index[1]		Consumer Price	GNP Implicit Price	Gross Average Hourly Earnings of Production or Non-supervisory Workers (US$)[5]			
		Industrial Commodities (1967 = 100)	All Commodities (1967 = 100)	Index[2] (1967 = 100)	Deflator[3,4] (1982 = 100)	Metal Mining (SIC 10)	Primary Non-ferrous Metals (SIC 333)	Chemicals and Allied Products (SIC 28)	Electric and Electronic Equipment (SIC 36)
1980	Avg.[6]	304.1	293.4	272.4	195.51	11.55	11.98	9.96	8.21
1981	Avg.	304.1	293.4	272.4	195.51	11.55	11.98	9.12	7.62
1982	Avg.[7]	312.3	299.3	289.1	207.15	12.33	12.94	9.96	8.21
1983	Avg.	315.8	303.1	298.4	215.63	12.57	13.43	10.59	8.65
1984	Avg.	322.6	310.3	311.1	108.1	13.05	13.43	11.08	9.04
1985	Avg.	323.9	308.8	322.2	111.7	13.39	13.75	11.56	9.47
Jan	1986	323.8	308.9	328.4	—	13.41	13.68	11.87	9.58
Feb	1986	318.9	304.4	327.5	—	13.46	13.80	11.83	9.57
Mar	1986	314.0	300.3	326.0	113.5	13.41	13.91	11.80	9.60
Apr	1986	311.6	298.2	325.3	—	13.47	13.89	11.84	9.60
May	1986	311.6	299.2	326.3	—	13.40	13.79	11.90	9.63
Jun	1986	311.8	299.0	327.9	114.2	13.50	13.50	11.95	9.59
Jul	1986	308.5	297.4	328.0	—	13.33	13.30	12.05	9.67
Aug	1986	307.9	297.2	328.6	—	12.96	13.13		9.64
Sep	1986	308.7	297.5	330.2	115.0	13.04	13.28	12.03	9.70
Oct	1986	309.6	298.4	330.5	—	12.85	13.16	12.08	9.67
Nov	1986	309.8	298.7	330.8	—	12.75	13.14	12.17R	9.73
Dec	1986	309.3	298.1	331.1	115.3	12.70	13.03	12.20	9.82
Jan	1987	313.6	300.9	333.1	—	12.94	12.98	12.18	9.84
Feb	1987	314.9	302.2	334.4	—	12.99	12.83	12.21	9.84
Mar	1987	315.7R	302.7R	335.9	116.2	13.04	12.79	12.24	9.84
Apr	1987	317.4	305.1	337.7	—	13.16	12.90R	12.30	9.82
May	1987	318.6	307.3	338.7	—	12.97R	12.92P	12.31R	9.83
Jun	1987	320.2	308.5	340.1	117.2	13.02P	12.93P	12.27R	9.84R
Jul	1987	322.6	310.2	340.8	—	—	—	12.35P	9.87P

P = Preliminary R = Revised since last month

[1]US Bureau of Labor Statistics, Washington, D.C.: "Producer Prices and Price Indexes," (formerly "Wholesale Prices and Price Indexes"). Producer Price Indexes are revised four months after they are first released to reflect the availability of late reports and corrections by respondents.

[2]US Bureau of Labor Statistics, Washington, D.C.: Consumer Price Index for All Urban Consumers, US City Average, All Items.

[3]US Department of Commerce, Washington, D.C.: Bureau of Economic Analysis, National Income and Wealth Division: "Survey of Current Business." The GNP Implicit Price Deflator is published quarterly, and seasonally adjusted.

[4]The basis for calculation of this index was revised to 1982 = 100. 1984 and 1985 figures have been adjusted to that basis. The basis for calculation prior to 1984, 1972 = 100.

[5]US Bureau of Labor Statistics, Washington, D.C.: "Employment and Earnings." All data based on 1972 revision of SIC Manual. Data for 1970-1976 are adjusted to the March 1977 benchmark. Data for 1977-1978 are adjusted to the March 1979 benchmark. Data for January 1979 and beyond are adjusted to the March 1980 benchmark.

[6]Monthly data 1970-1978 for Producer Price Index-Industrial Commodities, Consumer Price Index, and Employment and Earnings SIC codes 10, 333, and 28 and quarterly data for GNP Implicit Price Deflator appear on pages 4.6-4.8 of Report 139. Monthly data 1977-1978 for Employment and Earnings SIC Codes 10, 333, and 28 appear on page 33 of Report 147. Monthly data 1970-1978 for Employment and Earnings SIC Code 36 appear on page 23 of Report 154. Monthly Data 1977-1980 for Producer Price Index-All Commodities, appear on page 21 of Nuexco Report 158.

[7]Monthly data 1979-1982 for all listed indices appear on page 41 of Report 184.

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